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Neuroprotective Spice Herbs for Neuroinflammation and Neurodegeneration Diseases

Khan Waqar Ahmad,[1]* Gang Wang,[1] Ali Shoujat[2]

[1]School of Biological and Agricultural Engineering, Jilin University, China

[2]School of New Energy and Environment Jilin University, China

Abstract

Traditional medicine has received more attention in recent years. Numerous plants have been employed in medicine to treat neurological disorders like AD and other memory-related problems. Traditional uses for dietary, spice, and food additive medicinal purposes included the use of, Nigella sativa, Crocus sativus, Ferula assafoetida, Coriandrum sativum, Zataria multiflora, Thymus vulgaris Cats Claw, and Carotenoids, monoterpenes, and polyphenol chemicals, which are the main ingredients in these plants, improved neurological processes. These healing plants improved antioxidant production, reduced oxidative stress, and prevented the neurological system's acetylcholinesterase enzyme from working. Reduced production of proinflammatory cytokines such IL-6, TNF-an ,IL-1b, NF-Kβ, Bax Protein, Bcl-2,Caspase-3 and total nitrite is another way that plants are neuroprotective. As a result, the effects of the aforementioned medications and their active ingredients improved neurodegenerative diseases, indicating their therapeutic promise in diseases like AD and depression that are linked to neuro-inflammation and neurotransmitter deficit.

Keywords: Medicinal spice herbal plant, Memory nervous system, Traditional medicine

Introduction

Parkinson's disease (PD), Alzheimer's disease (AD) and (MS) are examples of neurodegenerative diseases that cause delayed neuronal death along with loss of cognitive and sensory abilities.[1] These diseases have recently been linked to several multifactorial etiologies, societal issues, and financial difficulties.[2,3] Anti-inflammatory medications may also halt the progression of neurodegenerative illnesses like AD. (NSAIDs) may lower the chance of developing Alzheimer's disease , according to numerous research.[4,5] In Parkinson's disease (PD), neuronal degeneration is caused by pathological processes such as inflammation, oxidative stress, apoptosis, mitochondrial malfunction, and hereditary factors.[6] In AD[7] and PD, it has been suggested that increased lipid peroxidation may kill off dopaminergic and cholinergic neurons.[8] The brain contains a variety of enzyme-based and non-enzymatic antioxidants, including total thiol groups superoxide dismutase (SOD).[9,10] The (CNS) is especially susceptible to peroxidation processes since it also contains a high level of PFA.[9] The brain has less antioxidant activity than other tissues, which makes it more vulnerable to oxidative damage.[11] Plant body part like leaves, roots, stems, fruits, seeds and flowers were employed supplementary therapies in traditional medicine, curcumin, Resveratrol, polyphenols, ginsenoside, triptolide, and other herbal extracts have neuroprotective properties.[12]

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***Corresponding author:** Khan Waqar Ahmad, School of Biological and Agricultural Engineering, Jilin University, Changchun 130022, China

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phytochemicals found in herbal products. The herb's component(s) has (have) more biological activity.[13,14]

The aim of the present evaluation study was to emphasize the beneficial effects of numerous medicinal plants that have historically been used for dietary, spice, food additive, and diverse therapeutic purposes on induced neurotoxicity.

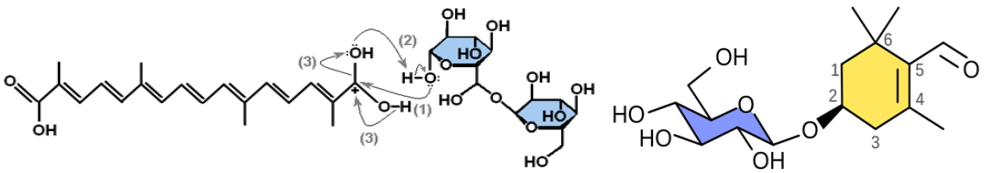
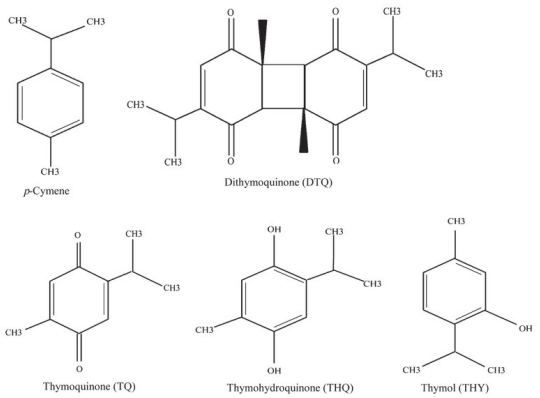
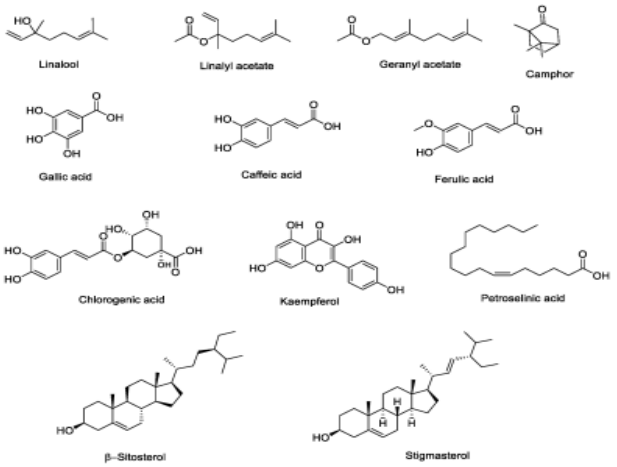
Methods

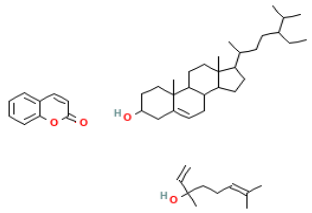
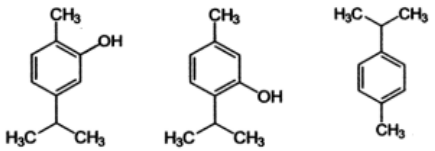
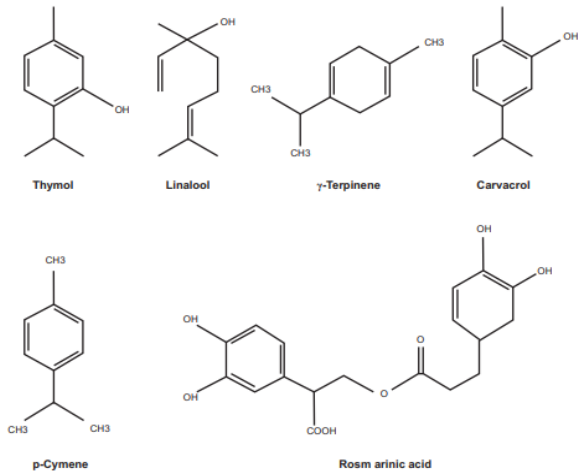
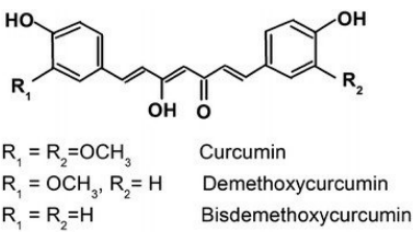
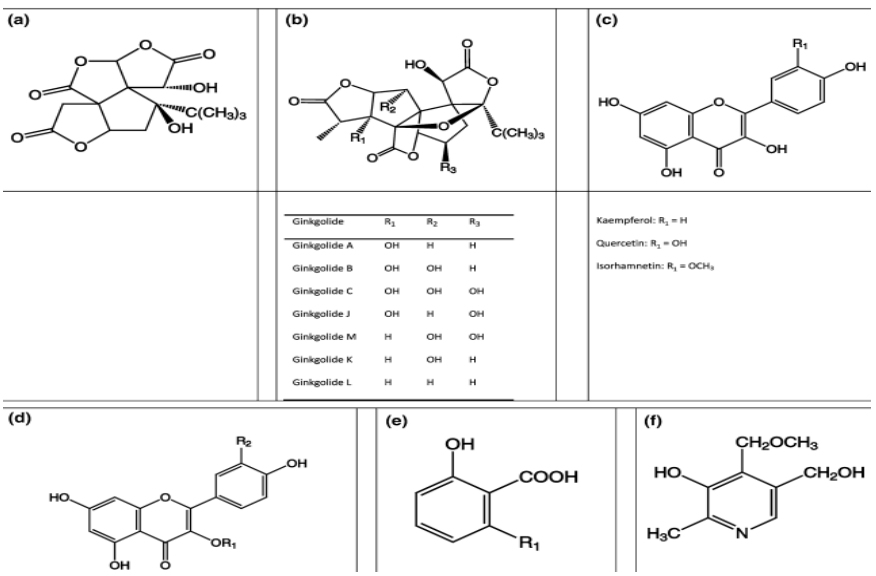
Up until the end of August 2023, the information for this review was gathered from databases like, Web of Science, PubMed, Scopus and Google Scholar. The terms "neuroprotective" or "neurotoxicity" were also used, as well as "Crocus sativus," "Nigella sativa," "Coriandrum sativum," "Ferula assafoetida," "Thymus vulgaris," "Zataria multiflora," and "Curcuma longa." Other search terms included "Ginkgo biloba" " All research that resulted in alterations in neurotransmitter release, behavioral changes, oxidant/antioxidant pro-inflammatory cytokines and parameters, were included, including in vitro studies, review articles, animal studies and clinical trials. The exclusion criteria included unpublished data and letters to the editor.

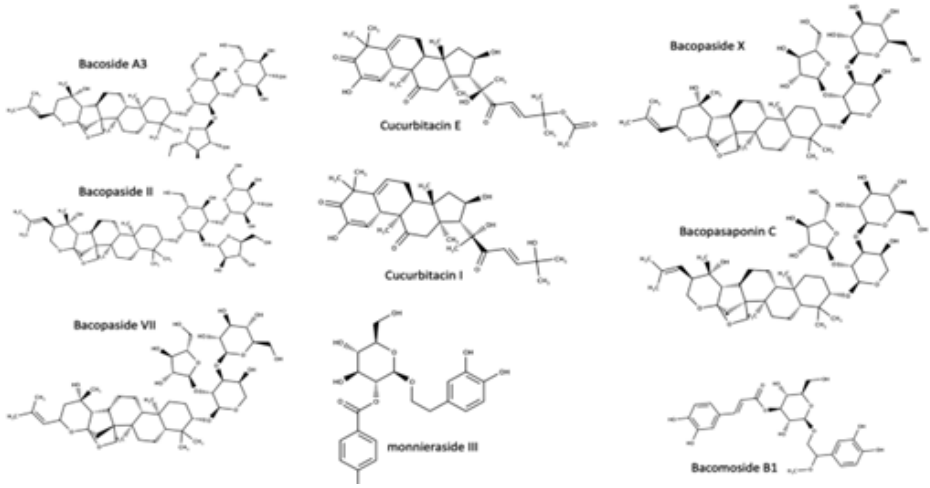
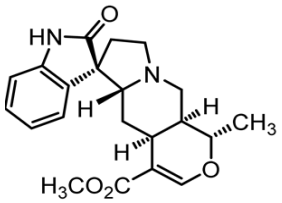
Neuroprotective Effects of Medicinal Plants

Crocus sativus

Saffron, is a member of the Crocoideae superfamily and is grown in a number of nations, with Afghanistan, Iran, and Spain, Turkey.[15] A small piece of the yellowish style from the C. sativus plant is linked to the dried, dark-red stigma that makes up saffron. In many parts of the world, it is primarily utilized as an herbal medication.[16] There are 150 distinct chemicals in saffron, including sugars, polypeptides, lipids, water, minerals, and vitamins. The primary biologically active components of saffron are crocins, a group of carotenoids that are all red, water-soluble, Picrocrocin, another saffron component with a bitter flavor.[17]

Saffron picrocrocin	
N. sativa L. seeds.	
Coriandrum sativum	

Ferula assafoetida	
T. vulgaris	
Z. multiflora	
C. longa	
Ginkgo biloba's	

Water hyssop	
Cats Claw	

C. sativus of medicinal properties

Crocus sativus is a plant used in traditional Iranian medicine to address mental health issues. Components of C. sativus have recently been utilized to relax smooth muscle and treat various neurological diseases.18e20 C. sativus extract has been shown to have anticonvulsant and anti-Alzheimer effects in both human and animal models.[18-20] Crocin, the primary component of C. sativus, has powerful antioxidant effects by lowering MDA levels.[21,22] In addition, mice with aluminum chloride-induced neurotoxicity were treated for 45 days with Zaffron extract (200mg/kg) and honey syrup.[23,24] The effectiveness of Zaffron (30mg/day) for the treatment of mild-to-moderate AD in patients 55 years and older was found to be on par with donepezil, and the frequency of side effects from saffron extract, with the exception of vomiting, was on par with donepezil.[25] Similar to this, 46 patients with mild-to-moderate Alzheimer disease experienced enhanced cognitive functioning after using C.Sative for 16 weeks.[26] Similar to the effects of fluoxetine and imipramine (100mg/day), C.Sative (30mg/day) was effective in the treatment of depression for 6 weeks.[27] The findings demonstrated that C. sativus 80 mg and fluoxetine (30mg/day) and were more beneficial than C. sativus 40mg for treating mild to moderate depressive disorders.[28]

Nigella sativa

The annual plant Nigella sativa L., often known as Nigella sativa, is a member of the Ranunculaceae family and is commonly grown in the Mediterranean region as well as in, the Middle East, Western Asia and Eastern Europe. Various Persian delicacies, including bread, pickles, sauces, and salads, have been spiced with Nigella sativa seeds.[29] Oil, protein, glucose, and fiber are among the chemical components of Nigella sativa seeds.oleic acid, Linoleic acid, arachidic acid, palmitic acid, stearic acid, eicosadienoic acid, myristic acid linoleic acid are the chemical components of N. sativa's fixed oil.[30] P-cymene (37.3%), Thymoquinone (TQ) (13.7%), Carvacrol (11.77%), and Thymol (0.33%) are the main phenolic chemicals found in N. sativa seeds.[29-32]

Medicinal properties of N. sativa

The medicinal plant N. sativa is well known for having strong antioxidant properties.N. sativa is said to have preventive benefits against kidney injury.[33,34] The cognitive deficiencies in spatial awareness brought on by chronic cerebral hypo perfusion in rats could be greatly improved by N. sativa seeds.[35] Furthermore, N. sativa lowered the AChE activity and oxidative stress in the rats' brains and restored learning and memory deficits brought on by scopolamine.[36] N. sativa oil's antioxidant effects on rheumatoid arthritis (RA) patients revealed that N. sativa decreased the levels of IL-10, MDA, and NO in the blood. Additionally, N. sativa lowered oxidative stress and enhanced inflammatory responses in RA patients.[37] Neuroprotective effects of thymoquinone (TQ) and N. sativa on various nervous system disorders such as epilepsy AD, and neurotoxicity have been reviewed Figure 1.[38-41]

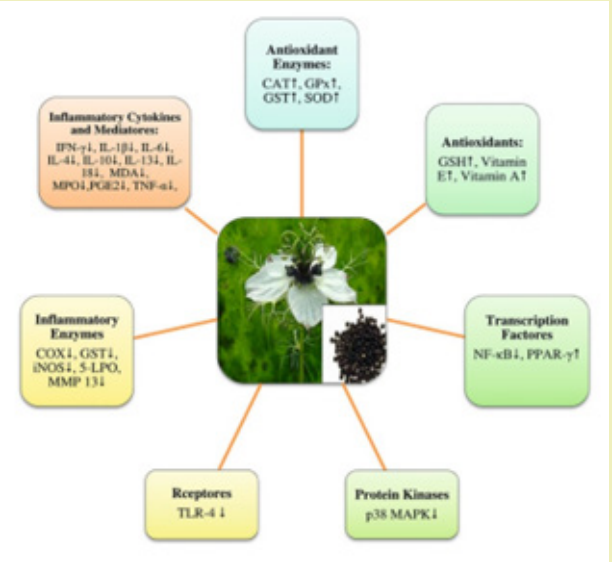


Figure 1: Different molecular targets of N. sativa and thymoquinone in inflammatory diseases. cyclooxygenase GPx: catalase CAT: reduced glutathione; GST: glutathione peroxidase; GSH: Glutathione-S-transferase; IL: interlukine; IFN-γ: interferon gamma; 5-LPO: 5-lipooxygenase; iNOS: inducible nitric oxide synthase; MPO: myeloperoxidase; MMP: matrix metalloproteinase; p38MAPK: p38 mitogen-activated protein kinases; SOD: superoxide dismutase; NF-κB: nuclear factor-kappa B. TLR4: toll-like receptor; PPAR-γ: peroxisome proliferator-activated receptor γ; TNF-α: tumor necrosis alpha.[129]

Coriandrum sativum

The herb coriander which belongs to the Apiaceae family of parsleys, is an annual. In Persian, this plant is typically referred to as Geshniz. The Mediterranean region is the plant's natural habitat, and Coriandrum sativum is widely cultivated worldwide.[42,43] Fresh herb oil is primarily composed of aliphatic aldehydes (primarily C10-C16 aldehydes), which have a fetid scent,[44] while the oil extracted from coriander fruit is primarily composed of linalool and a few other oxygenated monoterpenes and monoterpene hydrocarbons.[45] Additionally, coriander contains a significant number of essential oils (EO), which are crucial for brain and development activities, as well as lipids like petroselinic acid. Linalool, linoleic, and linolenic acids make up most of the coriander essential oil.[46] Linalool (60–70%) and hydrocarbons (20%) are present in coriander seed oil, although the herb oil's makeup is entirely different from that of the seed oil.[47]

Medicinal properties of C. sativum

The antibacterial and antirheumatic properties of C. sativum seed extract make it a popular ingredient in lotions and shampoos.[48] C. sativum has been advocated for use in Iranian traditional medicine to treat sleeplessness.[49,50] Before going to bed, it has been recommended to take a single dose of crushed plant seeds, fresh leaf extract, and tea to help with anxiety and sleeplessness.[49] Other traditional treatments have been found utilize C. sativum seed in similar ways.[51] The anxiolytic effect of the C. sativum leaves extract (200mg/kg) was demonstrated by an increase in the amount of time spent in open arms and the proportion of open arm entrances.[52] Using the maximal electroshock seizure paradigm and pentylenetetrazole (PTZ) as an anticonvulsant, the anticonvulsant activity of coriander seed aqueous (0.5g/kg, i.p.) and ethenolic (3.5 and 5g/kg, i.p.) extracts was investigated. [53,54]

Ferula assafoetida

which is derived from the exudates of the plant's living subterranean tap roots, rhizome is a member of the Apiaceae family. In Iran, F. assafoetida, also known as gum-resin, is called "Anghouzeh," "Khorakoma," and "Anguzakoma."[55] 25 chemicals were found in the hydro distilled oil, with e-1-propyl sec-butyl disulfide being a significant component.[56]

F. assafoetida of medicinal properties

Researchers are interested in F. asafoetida (Apiaceae) because of its therapeutic and dietary benefits. Plants' roots, new shoots, and leaves are consumed as vegetables. The root of the plant, Ferula asafoetida, is used as an antipyretic, and its leaves are anthelmintic, carminative, and diaphoretic.[57] epilepsy, Asthma, , flatulence, stomachaches, sluggish digestion, intestinal parasites and influenza are only a few of the conditions that are treated with F. asafoetida in traditional medicine.[58] Also mentioned are the sedative, analgesic, expectorant , stimulant, antiperiodic, carminative, antipasmodic, ant-diabetic , vermifuge, emmenagogue, anti-inflammatory, laxative, contraceptive, and anti-epileptic actions of F. asafoetida oleo-gum resin.[59] Studies have been done on F. asafoetida's effects on muscarinic receptors and potential pathways for functional antagonistic effects on guinea-pig tracheal smooth muscle.[60,61] On smooth muscles, F. assafoetida has a relaxing effect. Its potential processes have been explored.[62] Acute and sub chronic toxicity of F. asafoetida was assessed in a study, and the findings showed that neither a single oral treatment of this plant (500 mg/kg) nor repeated doses (250mg/kg) over the course of 28 days did not result in rat mortality or evident toxicological indications.[63] The oleo gum resin of F. asafoetida has also been shown to improve regeneration and re-myelination while reducing lymphocyte infiltration in neuropathic tissue in mice.[64] Additionally, research has indicated that F. asafoetida resin may inhibit monoamine oxidase B which makes it a viable treatment for neurological diseases including and Alzheimer's and Parkinson's.[65] Meanwhile, acetylcholinesterase (AChE) inhibition by Ferula asafoetida has been demonstrated in vivo as well as in vitro on the neurological system of the snail. Researchers

have hypothesized that Ferula asafoetida's ability to improve memory may be due to its ability to inhibit AChE in the rat brain.[66] Rats' memories were enhanced by the plant extract in dose-dependent ways in behavioral models including raised plus maze. The higher dose (400mg) of the extract improved memory in the passive avoidance test, whereas the lesser amount (200mg) had no effect. [67]

Thymus vulgaris

There are about 38 species of this plant, which is found throughout subtropical regions.[68] The primary ingredients in TV are phenols, carvacrol (15%) and thymol (40%). In the winter, it has lower phenol concentrations. The essential oil also contains cineol, cymen, pinene, borneol, thymol methyl ether (2%), and esters.[68]

Medicinal properties of T. vulgaris

Thyme is a common ingredient in herbal teas and infusions in traditional medicine.[69] Bioactive thyme components have been shown to have antioxidant, antibacterial, antitussive, antispasmodic, and expectorant properties. Examples of these compounds include thyme essential oil (TEO) constituents, natural terpenoid thymol, flavonoids and phenolic acids and phenol isomer carvacrol.[70,71] Tocols and phenolic in thymus vulgaris oil (TO) have been found to directly interact with free radicals and reduce lipid peroxidation, according to research.[72] Additionally, it has been found that thymol therapy improves the antioxidant state in rat brain tissue.[73] Additionally, the results of behavioral experiments have shown that when given orally to rats for a week, thyme extract can have anxiolytic effects. In support of this claim, thyme extract increases the proportion of entry and the amount of time spent in the maze's welcoming arms.[74] The elevated plus maze (EPM) in mice exhibits anxiolytic effects due to kaempferol in thyme extract, according to the findings of animal experiments.[75] It has also been proposed that the thyme essential oil has a dose-dependent protective effect against the toxicity of alfatoxins.[76-78] Thymol also regulates the GABAA receptor and operates centrally by simulating or enhancing GABA function, according to research.[79] Thymol, a bioactive monoterpene derived from the thymus, has recently been shown to have neuroprotective and ameliorative effects on cognitive impairment induced on by scopolamine or amyloid b in rats.[80] Researchers have hypothesized that thymol's possible impact on GABA-mediated regulation of synaptic transmission may explain its neuroprotective properties.[81] Researchers discovered that TO could improve nicotinic Ach receptor activity, synaptic acetylcholine (Ach) which in turn could modify cholinergic function.[82]

Zataria multiflora

The Lamiaceae family includes Zataria multiflora (also known as Z. multiflora).[83] multiflrol (1), Multi-flotriol (2), a novel aromatic ester of p-hydroxy benzoic acid (3), and 3 recognized constituents— luteolin, dihydroxyaromadendrane , and a-tocopherolquinone—are all p-cymene derivatives.[84-86] carvacrol (33.65%), Thymol (37.59%), PARA-cymene g-terpinene (3.88%), (7.72%), and b-caryophyllene (2.06%) made up the majority of the plant oil.[87]

Z. multiflora of medicinal properties

luteolin, Terpens, di-, tri-,6-hydroxyluteolin glycosides and tetraethoxylated chemicals, among others, are present in Z. multiflora and may contribute to its medicinal effects.[88] Multifloral Z Boiss essential oil (ZEO) has preservation properties, but its strong flavor and scent have prevented it from being used in large quantities as a food preservative.[89] The plant's analgesic, antibacterial, and digestive properties are employed in traditional Iranian medicine.[88] Additionally, it has been shown that Z. multiflora essential oil exhibits in vitro antibacterial, antioxidant, and antifungal activities.[89,90] According to research, pomegranate juice wasn't able to match the ZEO's powerful antioxidative effects.[89] This plant has also been linked to anti-inflammatory, immune-regulatory, and anti-bacterial activities. Additionally, it has been claimed that administering Z. multiflora essential oil intravenously to rats could reverse the learning and memory deficits produced by Ab. Researchers therefore believed that zataria multiflora essential oil was a valuable source of a natural medicinal agent for reducing the cognitive symptoms of (AD).[91-93]

Curcuma longa

Southeast Asian nations cultivate the Zingiberaceae family plant known as curcuma longa (C. longa).[94] The flavonoid curcumin (diferuloylmethane), along with a number of volatile oils like atlantone, tumerone, and zingiberone, are what make turmeric active. Sugars, proteins, and resins are additional ingredients. The most thoroughly studied active component, curcumin, makes up 0.3% to 5.4% of raw turmeric.[95]

C. longa of medicinal properties

Curcumin is a naturally occurring polyphenol and non-flavonoid substance found in some plants, including Curcuma longa. Kulkarni stated that dopamine, norepinephrine, and 5-HT levels in the CNS can be increased by curcumin water soluble extract.[96] Inhibitory effects of curcumin derived from Curcuma longa have been seen in cell culture and animal models for PD, apoptosis, ROS production, cytokines production, platelet aggregation, cognitive impairments and brain oxidative damage.[97,98] On oxidative [99] and renal damage, 1000mg/kg of C. longa extract taken orally has been shown to be protective.[100] Curcumin (50, 100, or 200mg/kg) has reportedly been administered to rats to treat cognitive impairments and indications of mitochondrial dysfunction.[101] Additionally, there is evidence that curcumin has neuroprotective benefits in cerebral

ischemia and neuronal degenerative diseases. The rat brain is protected against focal ischemia by curcumin thanks to the increase of the transcription factors Nrf2 and HO-1 expression. [102-104] Additionally, researchers hypothesized that curcumin inhibits ER stress-related TXNIP/NLRP3 inflammatory activation, which is thought to exacerbate glutamate neurotoxicity in the rat hippocampus.[105-107] Curcumin's antioxidant capabilities are also connected to its neuroprotective benefits in PD. Wang observed that 6-OHDA-exposed human cell line SH-SY5Y showed curcumin restored ROS intracellular accumulation.[108,109] Curcumin (60mg/kg, body weight, orally) treatment for three weeks reduced the degeneration of striatum neurons in rats with 6-OHDA damage.[110] By increasing the GSH levels, curcumin shielded the neurons against ROS.Curcumin enhanced SOD levels in the 6-OHDA-lesioned striatum of mice[111] and 6-OHDA was produced in MES23.5 cells[112].The axons have been said to be protected from LPS degeneration by curcumin.[113] The inducible nitric oxide synthase (iNOS) antagonist BCl-2 may be overexpressed, which would then mediate the neuroprotective effects of curcumin. Curcumin is therefore useful in reducing NO-mediated degeneration. Curcumin also reduced NF-kB activation in LPS.[114-118] The plant's interaction with the GABA and opioid system may have analgesic and anticonvulsant properties. Plants on various disorders as clinical studies were shown in various mechanisms of therapeutic characteristics of medicinal herbs were summarized in Table 1.

Medicinal plants	Model of study	Results
C. Sativus	Depressant patients	C. Sativus has a similar impact to imipramine when treating mild to moderate depression.[119]
		When compared to a placebo, C. sativus could yield noticeably superior results on the Hamilton depression rating scale.[120]
		C. Sativus has a similar impact to fluoxetine when treating depression.[121]
		Was effective to treatment of mild to moderate depressive disorders.[122]
N. sativa	Asthmatic patients	Improvements in the results of the pulmonary function test (PFT), chest wheezing, and all asthmatic symptoms[123] less efficient than theophylline on the sGaw and lung function.[124]
		Reducing the research group's use of oral corticosteroids, β-agonists, and inhalers.[125]
		lowering plasma triglycerides, eosinophil count, and IgE. Raising the cholesterol level of HDL.[126]
	Sulfur mustard espoused patients	
	Allergic patients	
C. sativum	Diabetic patient	notable hypoglycemia response in type-2[127]
C. longa	Peptic ulcer patients	In the first and second week, the pain and discomfort in the abdomen pain well.[128]
Ginkgo biloba's	Neurodegenerative disease dementia patient	G. biloba leaf preparations are commonly used in the treatment of CNS disorders such as AD.[235]
Zataria multiflora	Alzhiamer disease Treatment in mice	ZMEO, or Zataria multiflora Essential Oil, offers protective quality. reduce the memory impairment in AD rats.[236]
Cats Claw Medicinal Plant	viral infections (such as herpes, Alzheimer's disease, HIV, arthritis, cancer diverticulitis, colitis, peptic ulcers, gastritis, hemorrhoids parasites etc	Cat Claw Medicinal Plant that reduced the diseases.
Water hyssop Medicinal Plant	Bacterial Patient	Thus, it helps combat bacterial infections and diseases in humans

Medicinal plant of ginkgo biloba's

The eastern Chinese province of Zhejiang is thought to be the origins of ginkgo biloba.[129,130] (AD) and other forms of dementia are treated with standardized (GBE), which is made from the dried leaves of the ginkgo tree.[131, 132] The cognitive function of the aged and Alzheimer's disease patients was improved in a number of clinical investigations,[133–137] however GBE in AD is not supported by other studies. After the publishing of two significant trials, the debate about the advantages of ginkgo biloba for various purposes has been stronger. 1) DeKosky and colleagues' GEM research[138] i) The study by McCarney and colleagues[139] Notably, numerous changes in energy metabolism, stabilization of the mitochondrial membrane potential, inhibition of cytochrome c release, upregulation of the anti-apoptotic Bcl-2 protein and downregulation of the pro-apoptotic Bax protein, reduced levels of caspase 3 and caspase 9 after oxidative stress, and a decrease in apoptotic cell death were reported. These changes on the apoptotic pathway and mitochondrial function appear to be crucial for their beneficial effects.[140-146]

Origin and history of ginkgo biloba

The world's oldest living tree species is the ginkgo biloba. The earliest known occurrence of the Ginkgo species was during the Permian Period, between 286 and 248 million years ago. The only remaining member of the Ginkgo family is Ginkgo biloba. Buddhist monks who cared for the trees on holy sites are credited with their cultivation and preservation, as well as the trees' unusual malleability and disease resistance.[147] Frank Lloyd Wright loved gingko, which quickly made its way into American cityscapes.[148] Ginkgo has been used medicinally for approximately 5000 years, mostly in the treatment of asthma, in China.[149]

Leaf extract of ginkgo biloba

Ginkgo leaves have been utilized for therapeutic purposes for a very long time. Early in the 1970s, Karlsruhe, Germany's Dr. Ginkgo biloba extract preparation and created highly concentrated and stable extracts from Ginkgo biloba leaves.[150] According to some theories, the pharmacologically active components of Ginkgo biloba are flavonoids and terpenoids.[151,152] Ginkgo biloba 's solubility in water is caused by the presence of organic acid.[153] The significant investigations of Y Luo and others that demonstrate the neuroprotective properties of this herbal extract in cell and animal-based models have engaged in a variety of preclinical study assessing Ginkgo biloba effects.[154–160] With varying degrees of success, Ginkgo biloba has been used to treat and prevent neurodegenerative dementias brought on by aging, Parkinson's disease (PD), Alzheimer's disease (AD), and neurosensory disorders (such as tinnitus).[161,162] Ginkgo biloba to treat multi-infarct dementia, depression, cerebral insufficiency, stroke, thrombosis, myocardial ischemia and (POAD), which is characterized by symptoms like memory loss, difficulty concentrating, anxiety, and confusion. Additionally, its effects on traumatic brain damage, hypertension, and sexual dysfunction brought on by antidepressants[163] have been investigated.[164]

Components of GBE

Ginkgo biloba is made up of a variety of components, including trilactonicditerpenes, ginkgolides A, B, and C (ginkgolides J and M are also present, but at a lower level) Figure 1. There are also flavonoids such, proanthocyanidins isorhamnetins, trilactonic sesquiterpene and quercetin. Other components have also been identified, including, ginkgolic acid, D-glucaric acid, hydroxykynurenic, rhamnose, protocatechuic, kynurenic, shikimic acids and vanillic. In particular, it has been demonstrated that ginkgolides operate as (PAF) antagonists, preventing platelet aggregation and promoting blood flow.[165] Due to their phenolic structures, flavonoids are recognized to be among the most potent antioxidants among different polyphenols and to also function as heavy metal chelators.[166] They have been studied clinically in cardiovascular problems[167] Additionally, in preclinical models of AD[168] and stroke, Ginkgo biloba demonstrated neuroprotective and anti-inflammatory characteristics.[169]

Pharmacological importance

Despite existing for more than 200 million years, ginkgo has only recently received significant research attention. Due to its incredible vibrancy, there has been an increase in research into its potential use in food, supplements, and health. Fresh or dried leaves and seeds are the main components of the ginkgo tree that have medicinal benefits. It contains a lot of active substances that are recognized to have pharmacological value Figure 2. The active ingredient in GBE derived from ginkgo leaves enhances blood circulation, strengthens capillary walls, prevents clot formation, and guards against damage to nerve cells from oxygen deprivation. The leaf extracts are used to treat dementia diseases like memory loss and focus issues. The extract also has anti-asthmatic properties.[170] Anti-oxidant,[171] anti-inflammatory,[172] anti-radical[173] and neuroprotective capabilities against neurodegenerative diseases as AD[174, 175] and PD.[176] While complex mixes like blueberries or chocolate offer benefits due to the preventing AD. Pure antioxidants may also interfere with tightly controlled stress responses. AD, memory improvement, dementia of vascular origin, cognitive abnormalities, and positive benefits of the Ginkgo biloba plant's antioxidative actions in combination with other medications that increase their efficacy Figure 3.[177,178] In cases of brain damage, ginkgo biloba can act as a neuroprotective medication and a reinforcing antidepressant.[179] This plant alters cerebral blood flow, which may lessen weariness and inattentiveness.[180] Other investigations[181,182] GBE has beneficial effects on schizophrenia, depression, anxiety, and psychosis.[184] It also promotes cerebral blood circulation.

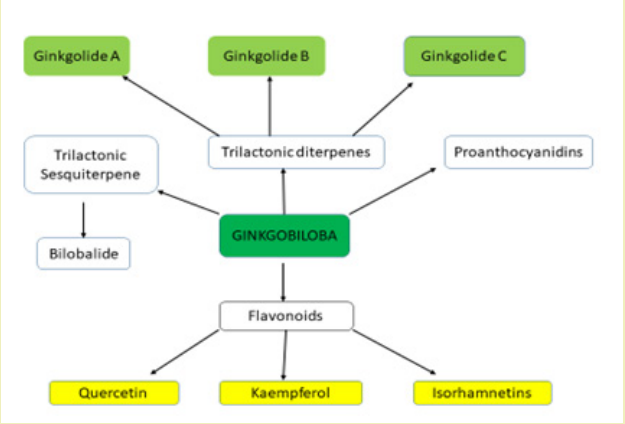


Figure 2: Diagram illustrating the several GBE active components. It is challenging to identify a single mode of action for GBE due to its wide-ranging actions, which instead support a pleotropic effect.

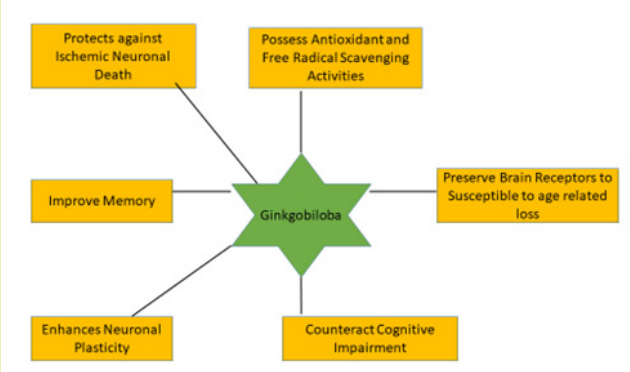


Figure 3: GBE includes a wide range of activities related to brain processes. The variety of activities that GBE's pleotropic effects.

Neurotherapeutic Effects of GBE Extract

Numerous in vitro and in vivo model studies have supported the neuroprotective effect of GBE.[185] Studies carried out in vitro shown that GBE shielded cultured neurons from degeneration brought on by hydrogen peroxide, hypoxia verapamil, amyloid, glutamate[186,199] nitric oxide (NO) 1-methyl-4-phenyl-1,2,3,6- tetrahydropyridine (MPTP. focal cerebral ischemia in mice and rats, hypoxia heat stress, sub chronic cold stress,[200-208] and amphetamine-induced behavioral sensitization have all been shown to reduce neuronal damage when administered intravenously or orally with EGb761[209] and in an amyotrophic lateral sclerosis transgenic mice model.[210] In addition to its ability to scavenge free radicals, EGb 761 has also been demonstrated to influence the transcription of various genes involved in the control of oxidative stress.[211] This is a crucial characteristic of EGB 761 since it may promote cellular tolerance to oxidative stress, safeguarding neuronal cells from oxidative damage frequently linked to neurological disorders like AD and PD. [212-221]

Water hyssop medicinal plant

Bacopa monnieri (L.) Wettst., is a creeping, bitter-tasting plant that grows in wet, marshy areas.[222] We predicted that this plant extract could lessen memory loss and neurodegeneration in animal models of Alzheimer's disease based on its reputation as a nerve tonic and its antioxidant activities. Astragalus, Brahmi,[223-225] medicine, Bacopa monnieri is used to cure a variety of diseases and boost memory.[217] Bacopa monnieri may enhance cognition, particularly memory and learning, according to systematic evaluations of early research,[227-228] however the effect wasn't noticeable until after many weeks of treatment.[226] 2019 saw the FDA send letters of warning to producers of dietary supplements containing Bacopa monnieri for making unsubstantiated and unlawful health claims about the treatment or prevention of Alzheimer's disease, gastrointestinal disease, hypoglycemia, anxiety and blood pressure. The FDA claimed that none of these or any other medicinal uses for Bacopa monnieri products have been authorized.[223-226]

Cats claw medicinal plant

Furthermore, the interaction of its antioxidant activity with free radicals superoxide anion (O2), 1, 1-diphenyl-2-picrylhydrazyl (DPPH), and hydroxyl (HO), peroxy (ROO), and hypochlorous acid (HOCl) and hydrogen peroxide (H2O2), has been assessed.[227-229] Uncaria tomentosa extract contains quinic acid (QA), a biologically active substance that has the ability to suppress NF-KB expression. If QA contains antioxidant action is unknown. Batch-2 is a brand-new aqueous cat's claw extract. In this study, we examine batch-2's antioxidative activity and protective effect on 6-OHDA-induced apoptosis in SH-SY5Y cells using QA as an internal reference.[230] Studies in cell cultures are the only source of evidence for anti-inflammatory activity. And has not been proven in randomized control human trials.[231-232] Numerous other conditions, such as HIV, Crohn's disease, multiple sclerosis, systemic lupus erythematosus (SLE or lupus), endometriosis, kidney issues, bladder cancer, and Alzheimer's disease are being examined in relation to cat's claw. Before scientists can determine whether it is beneficial, more study is required.[233]

Results and Discussion

The effects of the aforementioned medications and their active ingredients enhanced neurological diseases, indicating their therapeutic promise in diseases like AD and depression that are linked to neuro-inflammation and neurotransmitter deficit.

Iriti[234] reported that the focus will be on the and anti-inflammatory activity and antioxidant exhibited by particular molecules found in or remedies food plants. recommended by herbal medicines, as these are important factors in the etiopathogenesis of both neurodegenerative and neurological disorders.

Faridzadeh[235] studied Aromatic plants with antioxidant, anti-inflammatory, and neuroprotective properties include, lavender (Lavandula angustifolia), sage (Salvia officinalis) and rosemary (Salvia Rosmarinus). Additionally, they have demonstrated promise in the treatment of common neurological conditions such as AD, PD,migraines, and cognitive impairments.

Ratheesh[236] investigated Natural remedies and medicinal plants, including wolfberry, ginseng, curcumin, resveratrol, Baccopa monnieri and Withania somnifera (ashwagandha), GBE have been used to treat neurological disorders and symptoms that have been documented in in vivo or clinical trials. These medicinal plants against Neurodegenerative diseases.

Roy[237] one of the information collected With an emphasis on their mode of action and therapeutic potential, this review will emphasize the significance of herbal plants and their phytoconstituents against neurodegenerative disorders and other related conditions.

da Costa[238] suggested that the Using the herbs and essential oils of many species of medicinal plants is one way to combat this, since they include a number of bioactive components and phytochemicals that have the ability to protect neurons. Furthermore, they have favorable responses to neurological conditions such dementia, oxidative stress, anxiety, cerebral ischemia, and oxidative toxicity, indicating their potential utility as supplemental therapeutic agents for the management of neurological conditions.

Khan[239] studied Our aim was to succinctly illustrate the benefits of various berries in terms of our comprehension of the pathogenetic pathways underlying neurodevelopmental disorders and neurodegenerative diseases.

Khan[240] recommended drug the 6-Amino Flavone is an effective neurotherapeutic drug in Neurological disorders causing neurodegeneration.

Khan[241] reported that Flavonoids is a neuroprotective agent against Neurogenerative diseases.

Conclusion

We suggest concentrating on neurotoxicity in various research (in vivo and in vitro) and examining the effects of therapeutic herbs on the brain system in this review. The aforementioned medicinal plants function in protective ways by raising SOD and catalase levels, restoring GSH, lowering MDA levels, and protecting neurons from free radical damage through antioxidant activities. These natural substances may have some protective effects due to a decrease in Ca2+, Na+, and an increase in K+ levels, or a "anti-glutamatergic" action. The aforementioned plants have neuroprotective properties that reduce inflammatory cytokines while increasing anti-inflammatory cytokines, inhibit acetylcholinesterase activity, reduce MDA levels in the nervous system by modulating glutamatergic and GABAergic neurons, and increase amino acids and serotonin (5-HT) levels in the neurotransmitter systems. Additionally, scientific and clinical studies showed that several herbs have anti-inflammatory, antioxidant, and immunoregulatory effects on a variety of diseases. This discovery assisted in recommending the usage of these herbs and key natural resource compounds.

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Conflicts of Interest

Authors declare that there is no conflict of interest.

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