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PHYTOCONSTITUENTS, PHARMACOLOGY, AND MODERN FUTURE PERSPECTIVES OF TRADITIONAL MEDICINAL PLANT *EVOLVULUS ALSINOIDES LINN.* (SHANKHPUSHPI)

Pradip Kushwaha*, Avinash Maurya, Sudheer Yadav, Vikas Yadav, Ramesh Chandra, Dr. Anil Kumar.

Pharmacy College, Itaura, Chandeshwar, Azamgarh, 276128.

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***Corresponding Author**

Pradip Kushwaha

Pharmacy College, Itaura, Chandeshwar, Azamgarh, 276128.

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ABSTRACT

Evolvulus alsinoides (L.) L., known as Shankhpushpi or Vishnukranti, is a medicinal plant of the family Convolvulaceae and is used traditionally in Ayurveda and Traditional Chinese Medicine. It is valued as a brain tonic for memory and cognition, and for the management of anxiety, depression, epilepsy, and amnesia. Phytochemicals like flavonoids, phenolics, alkaloids, terpenoids, steroids, triterpenoids, and resin glycosides contribute to the therapeutic potential. Preclinical studies have reported antioxidant, neuroprotective, anti-amnesic, memory-enhancing, anxiolytic, antidepressant, anti-inflammatory, antimicrobial, immunomodulatory, and hepatoprotective activities. This review considers its botanical aspects, traditional applications, phytochemistry, analytical techniques, pharmacological activities, neuropharmacological potential, mechanisms, safety, and research gaps. Most of the data are still only in the pre-clinical stage, which is encouraging. Further research should be directed toward active-compound characterization, extract standardization, advanced profiling, pharmacokinetic and toxicity studies, in-vivo validation, sustainable cultivation, Additional research should focus on active-compound characterization, extract standardization, advanced profiling, pharmacokinetic and toxicity studies, in-vivo validation, sustainable cultivation, formulation development, and well-designed clinical trials to establish therapeutic efficacy and safety.

KEYWORDS: *Evolvulus alsinoides*; Convolvulaceae; Phytochemistry; Bioactive compounds; Neuroprotective activity; Pharmacological activities; Antioxidant activity; Therapeutic potential.

INTRODUCTION

Carl Linnaeus initially described it in 1753 as Convolvulus *alsinoides.*[1,2] In 1762, he reclassified it into the newly established genus *Evolvulus.*[1,3] Most species are native to the Americas, with approximately 100 species in total.[4]

Evolvulus alsinoides (L.) L., which belongs to the Convolvulaceae family, is a medicinal herb used for a long time in traditional medicine practices, notably Traditional Chinese Medicine (TCM) and Ayurveda. The plant has several common names, including morning glory, Tu Ding Gui, Shankhpushpi, and Vishnukranti. Because of its long-standing medicinal use and the variety of pharmacological activities it shows.[5,6,7]

The medicinal significance of *E. alsinoides* is closely associated with its traditional use in the treatment of neurological and cognitive disorders. In traditional medicine practices, this plant has been used as a brain tonic and has been associated with the treatment of conditions such as anxiety, dementia, epilepsy, depression, amnesia, and other cognitive disorders. Different parts of the plant have also been traditionally used for respiratory, digestive, and other health-related conditions.[8,5]

The therapeutic potential of *E. alsinoides* is further supported by its diverse phytochemical composition. Several bioactive compounds have been identified in the plant, such as scopoletin, squalene, 4-hydroxycinnamic acid, stigmasterol, kaempferol, β-sitosterol, quercetin, lupeol, betulin, hexadecanoic acid, piperine, and vanillin. These secondary metabolites have been explored for their possible contribution to the therapeutic properties of the plant.[8,9,5]

Pharmacological research has demonstrated that *E. alsinoides* possesses a broad spectrum of biological activities. Reported activities include memory-enhancing, neuroprotective, antioxidant, anti-amnesic, antiepileptic, anticonvulsant, antifungal, anthelmintic, antimicrobial, and anti-anxiety effects.[9,10]

The neuropharmacological importance of *E. alsinoides* is particularly extraordinary. Experimental investigations have reported neuroprotective and memory-related effects,

supporting its traditional reputation as a medicinal brain tonic. The plant has also been investigated for antidepressant, immunomodulatory, antioxidant, anxiolytic and antidiabetic activities.[10,11,12,13]

Modern approaches such as preliminary phytochemical screening, chromatographic analysis, spectrometric methods, and Fourier-transform infrared spectroscopy (FTIR) have been described for investigating medicinal plants and their bioactive constituents. FTIR is particularly useful for the detection of functional groups and provides structural information through a rapid and non-destructive analytical approach.[14,15,16]

Despite its medicinal importance, *E. alsinoides* faces challenges related to its availability and propagation. The plant has poor seed viability and approximately 37% germination, while environmental conditions and indiscriminate harvesting can further restrict the availability of plant material for medicinal and research purposes.[9]

Therefore, the combination of its traditional medicinal importance, diverse phytochemical profile, and promising pharmacological activities makes *Evolvulus alsinoides* a valuable candidate for systematic scientific investigation. Further studies focusing on phytochemical characterization, antioxidant and neuroprotective properties, functional-group analysis, and identification of bioactive secondary metabolites may help establish a stronger scientific basis for its traditional applications and contribute to the development of potential therapeutic agents.

BOTANICAL DESCRIPTION AND TAXONOMY

Taxonomic rank	Classification
Kingdom	Plantae
Phylum	Streptophyta
Class	Equisetopsida
Subclass	Magnoliidae
Order	Solanales
Family	Convolvulaceae
Genus	*Evolvulus*
Species	*Evolvulus alsinoides* (L.) L.

Table Chart 1: Taxonomic Classification of Evolvulus alsinoides (L.) L.[17]

Common names: Dwarf morning glory (Other), Vishnukranta, Vishnugandhiy (Sanskrit), Shankapushpi (Hindi), Shankhavalli (Marathi), Shankvel (Kannada), Vishnukranti, Vishnu Kranthi (Malayalam), Kalisankha Vali (Gujarati).[18,20]

TRADITIONAL AND ETHNOMEDICINAL USES

Evolvulus alsinoides (L.) L. has been traditionally used for a long time and is appreciated for its bitter, febrifuge, anthelmintic, tonic, and nervine properties.[9,21] It has been traditionally employed to treat memory loss, epilepsy, anxiety, insomnia, stress-related conditions, fever, diarrhoea, digestive issues, respiratory problems, skin diseases, and infections.[18,21,22,23]



Fig 1. *Evolvulus alsinoides (L.) L.*

1. Ayurvedic and Traditional Importance

In traditional healing systems, *E. alsinoides* is considered a tonic for the brain and nervous system, known for its cognitive-enhancing, stress-resisting, and nerve-protecting effects.[9,21,22] Within Ayurveda, it is linked to Medhya Rasayana therapies, which focus on improving memory, intellect, and mental health. In traditional Chinese medicine, it is believed to nourish the heart and calm the mind, and has been used to address liver issues, neurological conditions, infections, and central nervous system disorders.[13,19,24,25]

2. Regional Uses

The whole plant and leaves are widely used across various regions. In India, it is traditionally applied for treating fever, sexually transmitted diseases, snake bites, and promoting hair growth.[22,26,27,29] In Africa and Southeast Asia, it serves as a tonic, fever reducer, anti-diarrheal, and worm expellant.[22,29] Leaf-based remedies have also been used for treating sores, bronchitis, and asthma, while other regional uses include managing dysentery, depression, digestive disorders, stomach complaints, and swollen glands.[22,23,30,31]

3. Plant Parts and Methods of Preparation

The entire plant is most frequently utilized, followed by the leaves, roots, and stems, depending on local traditions.[18,22] Common traditional preparations include decoctions, infusions, extracts, powders, boiled mixtures, and oil-based formulations.[18,21,22,29] Ayurvedic texts also mention *E. alsinoides* in connection with Medhya Rasayana herbal formulations.[38]

4. Traditional Uses Supported by Scientific Research

The medicinal effects of *E. alsinoides* are linked to its content of bioactive compounds such as alkaloids, flavonoids, phenolics, triterpenoids, and saponins.[9,18,21] Preliminary experimental studies support several traditional uses, demonstrating antioxidant, antimicrobial, anti-ulcer, neuroprotective, adaptogenic, and cognition-enhancing activities.[13,18,21,22,24,25] Nonetheless, most evidence is from preclinical research, and more rigorous clinical trials are needed to confirm its effectiveness, determine proper dosages, and ensure safety.[18,38]

Note: Since the traditional name Shankhpushpi has historically referred to multiple plant species, Ayurvedic references should be carefully evaluated when attributing specific traditional uses to *E. alsinoides*.[31,38]

TRADITIONAL AND ETHNOMEDICINAL USES OF *EVOLVULUS ALSINOIDES* (L.) L.

Sr. no	Plant parts	Traditional use/application	Traditional system/community	Traditional preparation/process	Ref.
1	Whole plant	Memory enhancement; brain tonic; nervous debility	Ayurveda; Indian ethnomedicine	Whole plant is converted into a paste and mixed with rice water; the preparation is traditionally taken on an empty stomach for memory enhancement.	[32]
2	Whole plant	Cognitive impairment, memory loss and nervous debility	Ayurveda / Indian traditional medicine	The herb is prepared as a decoction by boiling the plant material in water and is traditionally administered orally.	[32]
3	Whole plant	Fever, nervous debility and memory loss	Indian traditional medicine	The whole herb is decocted with cumin and milk and traditionally administered orally.	[32]
4	Whole plant	Fever associated with indigestion or diarrhoea	Indian traditional medicine	A decoction of the whole plant is prepared together with Ocimum sanctum and administered orally.	[32]
5	Whole plant	Fever, diarrhoea and intestinal complaints	South-East Asian traditional medicine	The entire plant is prepared as an infusion by steeping the plant material in water; traditionally used orally.	[33]
6	Whole plant	Febrifuge, tonic, antidiarrheal and anthelmintic applications	South Asian, South-East Asian and African traditional medicine	Fresh or dried whole plant is prepared as an infusion/decoction and administered orally according to local practice.	[32,33]
7	Whole plant	Diarrhoea	Indian ethnomedicine	Fresh plant material is crushed with water; the expressed juice is	[34]

				traditionally consumed orally.	
8	Whole plant	Insomnia	Kerala traditional knowledge	Approximately 20–25 g of the whole plant is washed and crushed into a paste; the paste is mixed with curd and traditionally consumed once daily.	[34]
9	Whole plant	Paralysis-related traditional application	Indian traditional knowledge	The whole creeper is boiled in water to prepare a decoction; the decoction is traditionally used externally as a bath, while saffron is administered separately with food.	[34]
10	Leaves	Asthma and chronic bronchitis	Indian traditional medicine	Leaves are dried and traditionally incorporated into a smoking preparation; the smoke is inhaled for chronic bronchitis and asthma.	[32]
11	Leaves	Mental disturbances	Indian ethnomedicine	Leaves are used in traditional medicinal preparations, including preparations administered for mental disturbances.	[32]
12	Roots	Fever, including intermittent fever	Indian ethnomedicine	Root decoction	[32]
13	Roots + Stems and leaves	Dysentery, fever, asthma and depression/psychiatric disorders	Sri Lankan traditional medicine	Extract/decoction	[35]
14	Roots + leaves	Wounds and other local complaints	Luo traditional medicine, Kenya	Roots and leaves are pounded together and applied locally; the same plant parts are also prepared as a decoction for oral use.	[36]
15	Whole plant + milk + ghee	Traditional reproductive/tonic application	Kerala traditional medicine	The whole plant is traditionally combined with milk and ghee and administered as a medicinal preparation.	[32]
16	Whole plant + oil	Hair-growth application	Indian traditional medicine	An infusion/preparation of the plant with oil is traditionally applied for promoting hair growth.	[33]
17	Flowers	Brain tonic; traditionally used to support memory and cognitive function	Indian traditional medicine / Ayurveda; folk medicine of western Maharashtra	Indian traditional medicine / Ayurveda; folk medicine of western Maharashtra.	[37]
18	Whole plant	Depression and nervous-system-related disorders	African ethnomedicine	Decoction/boiled preparation	[33]
19	Whole plant	Diarrhoea and intestinal worm infestation	Ethiopia, Kenya and Madagascar	Pounded plant/food preparation	[33]

20	Whole plant	Brain tonic, memory enhancement, epilepsy and anxiety-related applications	Reported traditional Chinese medicinal literature	Traditional medicinal preparations	[5]
21	Whole plant	Fever, worm infestation, ulcers, cough/asthma and cognitive/psychological disorders	Ayurveda	Traditional formulations/decoctions	[38]

Table 2: ***Traditional and ethnomedicinal uses of Evolvulus alsinoides (l.) L.***

MODERN MEDICINAL USES OF *EVOLVULUS ALSINOIDES* (L.) L.

Evolvulus alsinoides (L.) L., commonly known as Shankhpushpi or Vishnukranti, is traditionally and experimentally investigated for several medicinal applications. Cognitive enhancement, Anti-amnesic activity, Neuroprotective activity, Anxiolytic activity, Antidepressant potential, Anticonvulsant potential, Antioxidant activity, Anti-inflammatory activity, Hepatoprotective activity, antimicrobial activity.

Overall: Modern research mainly supports *E. alsinoides* as a promising neuropharmacological and antioxidant medicinal plant, but most evidence is preclinical, and clinical efficacy and safety require further investigation.

Evolvulus alsinoides **(Shankhpushpi/Vishnukranti) is used in contemporary pharmaceutical products and formulations.**

1. Shankhpushpi Syrup: This is traditionally sold for mental health, memory, and focus.

2. Shankhpushpi Churna Powder: This powdered herbal preparation is utilized in conventional recipes.

3. Shankhpushpi Tablets/Capsules: Marketed to support the nervous and cognitive systems.

4. Medhya Rasayana formulations: Shankhpushpi and other herbs are used in Ayurvedic preparations.

5. Brahmi-Shankhpushpi formulations: These are blended herbal products sold to help with memory and cognition.

6. Shankhpushpi extract: Concentrated or standardized herbal extract that is added to formulations and supplements.

PHYTOCHEMICAL PROFILE

Evolvulus alsinoides (L.) L. possesses a chemically diverse profile comprising primary and secondary metabolites. Reported constituents include carbohydrates, amino acids, phenolics, flavonoids, alkaloids, terpenoids, steroids, saponins, glycosides, coumarins, fatty acids, phytosterols, and resin glycosides. Their composition varies with plant part, geography, growth conditions, extraction solvent, and analytical method; therefore, chromatographically detected compounds should be distinguished from those confirmed by isolation and structural elucidation.[39–41]

1. Primary Metabolites

Primary metabolites include carbohydrates, amino acids, and fatty acids. An ethanolic whole-plant extract contained approximately 7.3 mg/g total carbohydrates, while GC–MS analyses reported fatty-acid-related and other low-molecular-weight metabolites.[39–41] Their direct contribution to the medicinal effects of E. alsinoides remains unconfirmed.

2. Secondary Metabolites

Phytochemical screening has reported alkaloids, flavonoids, phenolics, terpenoids, steroids, saponins, glycosides, and tannins.[39,40] HPTLC analysis detected alkaloids, flavonoids, phenolics, and quercetin; approximately 192 mg/g total phenolics and 26 mg/g total flavonoids were reported under the study conditions.[39] Other investigations have identified flavonoids, coumarins, triterpenoids, phytosterols, and resin glycosides.[40–48]

3. Phenolic Compounds

Phenolics, including quercetin and GC–MS-detected pyrogallol-related compounds, have been reported.[39–41] Isolation studies identified the phenolic glycosides evolvosides C, D, and E, whose structures were established using 1D/2D NMR spectroscopy.[43] Their antioxidant potential is of interest, although extract-level activity cannot be attributed to individual compounds without specific evidence.

4. Flavonoids

Flavonoids such as kaempferol and vitexin have been reported.[39,40] Evolvosides C, D, and E are flavanol glycosides related to kaempferol and were isolated from the n-butanol fraction.[43] Some isolated compounds showed anti-stress effects in animal models, providing preliminary preclinical evidence.[43]

5. Alkaloids

Alkaloids have been detected by phytochemical and HPTLC analyses.[39,40] Reported constituents include betaine and Shankhpushpin, along with unidentified alkaloid fractions.[40,41] Their identity, concentration, pharmacokinetics, and molecular targets require further investigation.

6. Terpenoids

Reported terpenoids include lupeol, squalene, phytol, viridiflorol, copaene, and terpinolene.[40,44] The essential oil contained cis-α-necrodol (~12.62%) as a major component under the reported conditions. These compounds warrant investigation for potential biological activities.

7. Steroids and Phytosterols

Steroids and phytosterols include β-sitosterol and stigmasterol.[39–41,44] HPTLC analysis reported approximately 92.75 mg/g stigmasterol in E. alsinoides under the specified analytical conditions.[44] Their specific contribution to neurological effects remains unclear.

8. Resin Glycosides

Characteristic Convolvulaceae-type resin glycosides, including evolvulic acids A–C and evolvulin I–III, have been isolated from E. alsinoides.[45–48] These contain structurally complex oligosaccharide-linked, hydroxylated fatty-acid-derived aglycones and represent an important specialized metabolite group.

9. Fatty Acids

GC–MS analyses have reported n-hexadecanoic (palmitic) acid, octadecanoic (stearic) acid, 9-octadecenoate, ethyl icosanoate, and related unsaturated fatty-acid metabolites.[40,41] Their specific pharmacological relevance requires targeted validation.

10. Other Constituents

Other reported constituents include the coumarins scopoletin, scopolin, and umbelliferone, together with volatile, aliphatic, and aromatic compounds.[20,41,42] GC–MS has also detected compounds such as benzoic acid, furfural derivatives, squalene, phytol, and cinnamaldehyde.[40,41] Such compounds should preferably be described as “GC–MS detected” or “tentatively identified” unless confirmed by isolation and structural analysis.

Overall, E. alsinoides exhibits considerable phytochemical diversity, particularly in flavonoids, phenolic glycosides, alkaloids, terpenoids, phytosterols, coumarins, fatty acids, and resin glycosides.[39–48] Further isolation, quantitative profiling, metabolomics, pharmacokinetic studies, and compound-specific biological investigations are required to establish definitive structure–activity relationships.

PHARMACOLOGICAL ACTIVITIES

Evolvulus alsinoides (L.) L. has demonstrated a broad pharmacological profile, with particularly strong preclinical evidence for **neuroprotection, memory enhancement, anti-amnesic, antioxidant, anxiolytic, anticonvulsant, antimicrobial, antidiabetic, immunomodulatory, and anti-inflammatory activities**. Recent reviews also emphasize its flavonoids, phenolics, alkaloids, terpenoids, and other secondary metabolites as potential contributors to these effects, although clinical validation remains limited.

1. Neuroprotective activity

Experimental model: Scopolamine-induced amnesia in Swiss albino mice; elevated plus-maze and Morri's water maze.

Extract: Ethanolic whole-plant extract of *E. alsinoides*.

Dose: 250 and 500 mg/kg, orally.

Major finding

- Improved cognitive performance.
- Reduced brain AChE activity.
- Increased reduced glutathione (GSH).
- Improved antioxidant status.
- Reduced brain **IL-1β, IL-6 and TNF-α** levels.
- Findings supported neuroprotective and nootropic activity.

Mechanism — stepwise flowchart

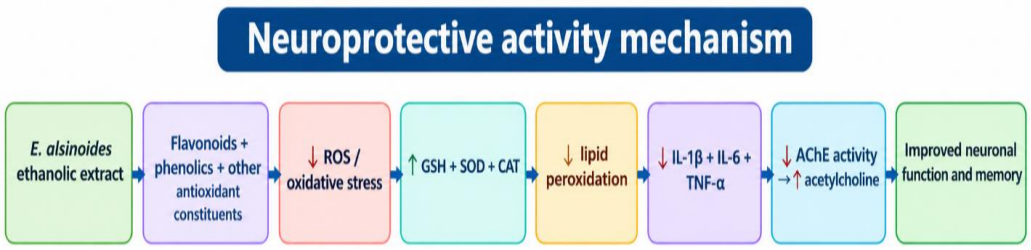


Fig 2: ***Neuroprotective activity mechanism.***[10]

2. Memory-enhancing activity

Experimental model: Cook and Weidley's pole-climbing, passive avoidance, active avoidance, step-down and shuttle-box paradigms in rats.

Extract: Ethanol extract, ethyl acetate fraction and aqueous fraction of *E. alsinoides*.

Dose: 100 and 200 mg/kg, orally.

Major finding

Both doses significantly improved learning and memory.

Extracts reversed scopolamine-induced amnesia.

200 mg/kg generally showed stronger activity.

Activity was compared with piracetam.

Mechanism — stepwise flowchart

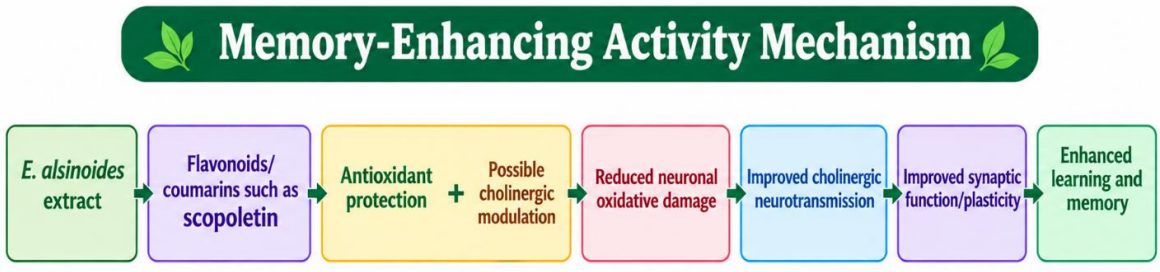


Fig 2: *Memory-enhancing activity mechanism.*[49]

Scopoletin has been specifically proposed as one contributor to the memory-enhancing activity, but this should be considered a **hypothesis rather than definitive proof for the whole extract**.

3. Anti-amnesic activity

Experimental model: Scopolamine-induced memory deficit/passive avoidance test in mice; acute and chronic stress models in rats.

Extract: Crude ethanolic extract.

Dose: 100 mg/kg for anti-amnesic activity; **100, 200, and 400 mg/kg** evaluated in stress studies.

Major finding

100 mg/kg reduced scopolamine-induced memory deficit.

- 200 mg/kg reduced stress-induced physiological alterations.

- Activity included reduction of stress-associated changes in corticosterone and other peripheral markers.

Mechanism — stepwise flowchart

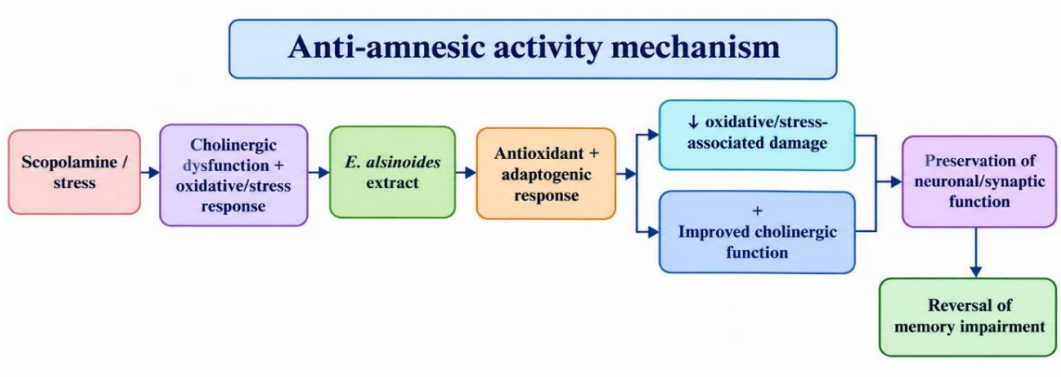


Fig 3: *Anti-amnesic activity mechanism.*[50]

4. Antioxidant activity

Experimental model: ABTS radical-scavenging assay; rat-brain lipid-peroxidation model; additional DPPH/FRAP studies.

Extract: Ethanolic extract and aqueous infusion.

Concentration: ABTS assay approximately **10–100 µg/mL**; ethanolic extract IC_{50} **33.39 µg/mL**.

Major finding

- Ethanolic extract showed significant ABTS radical-scavenging activity.
- Aqueous infusion showed an IC_{50} of **172.25 µg/mL**.
- Aqueous infusion inhibited brain lipid peroxidation with IC_{50} of **89.23 µg/mL**.
- Other studies also demonstrated DPPH, ABTS and FRAP activity.

Mechanism — stepwise flowchart

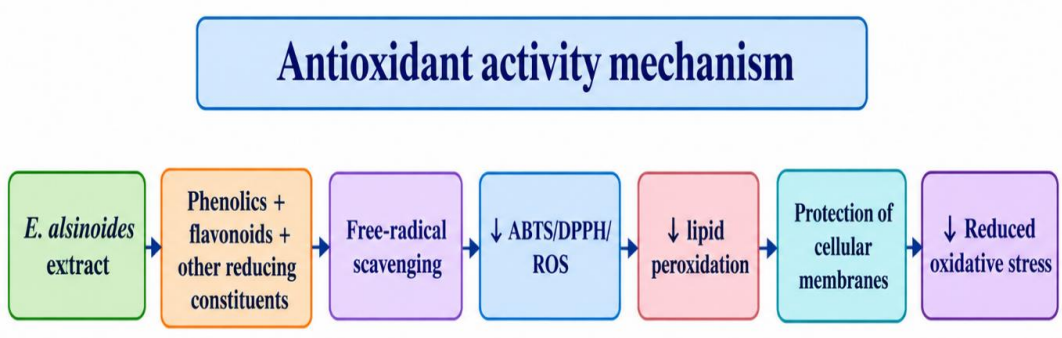


Fig 4: *Antioxidant activity mechanism.*[51]

5. Antidepressant activity

Experimental model: Forced-swim test and tail-suspension test in Swiss albino mice.

Extract: Ethanolic leaf extract.

Treatment: Oral administration for **21 days**; **400 mg/kg** was specifically associated with reduced hippocampal TNF-α expression and improved histopathology.

Major finding

Significant reduction in immobility in forced-swim and tail-suspension tests.

No evidence of nonspecific stimulant activity.

Reduced hippocampal TNF-α expression.

Antioxidant activity was also observed.

Mechanism — stepwise flowchart

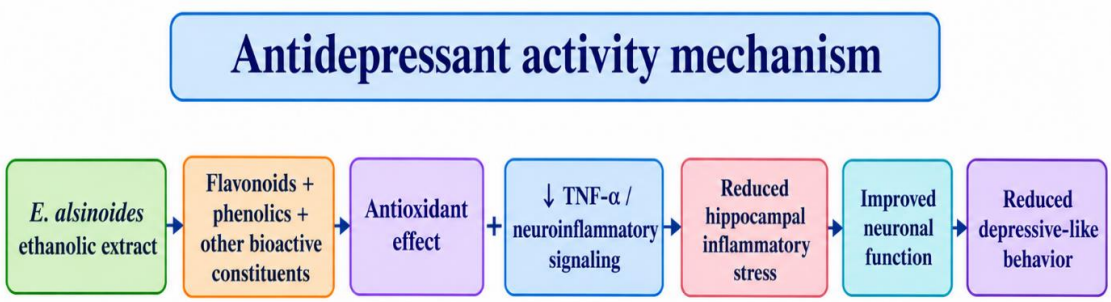


Fig 5:" *Antidepressant activity mechanism.*[52]

6. Anxiolytic activity

Experimental model: Elevated plus-maze and related behavioural models in rodents.

Extract: Ethanolic extract and ethyl-acetate fraction.

Dose: 200 mg/kg showed significant anxiolytic activity; higher dosing affected rotarod performance.

Major finding

- Increased open-arm exploration.
- Reduced anxiety-like behaviour.
- Ethyl-acetate fraction showed particularly notable activity.
- The study also reported antioxidant potential.

Mechanism — stepwise flowchart

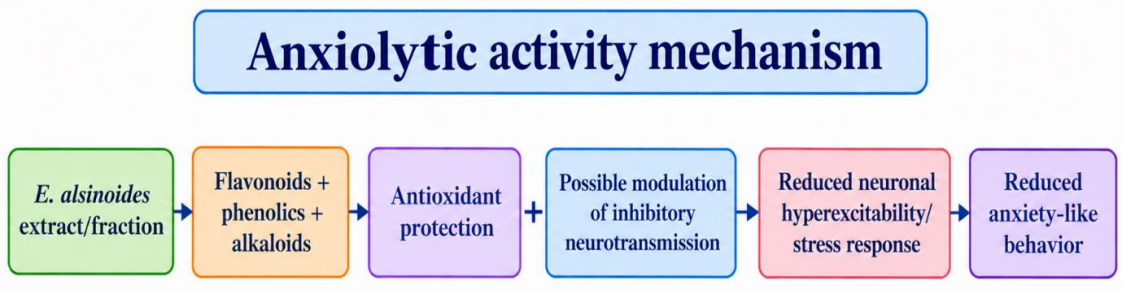


Fig 6: *Anxiolytic activity mechanism.*[53]

The GABAergic mechanism is **proposed**, not directly established in the anxiolytic study.

7. Anticonvulsant/antiepileptic activity

Experimental model: PTZ-induced seizures and maximal electroshock seizure (MES) models in mice.

Extract: Crude methanolic extract.

Dose: 50, 100, 200 and 400 mg/kg.

Major finding

Increased seizure latency in PTZ model.

400 mg/kg produced 100% protection against PTZ-induced seizures in the reported study.

Reduced seizure duration in MES model.

Effects at the highest dose were comparable with diazepam in some endpoints.

Mechanism — stepwise flowchart

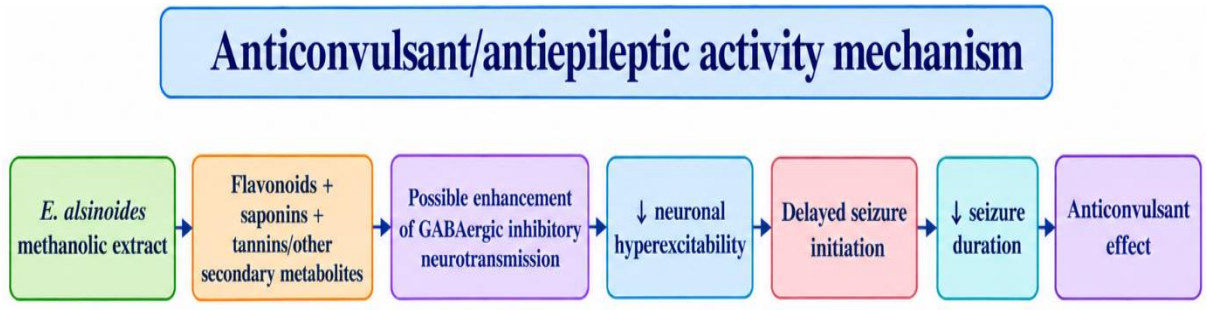


Fig 7: *Anticonvulsant/antiepileptic activity mechanism.*[54]

The original study itself proposed interaction with **GABAergic neurotransmission**, but molecular receptor-level confirmation is still required.

8. Antimicrobial activity

Experimental model: Agar diffusion and MIC/MBC assays against Gram-positive and Gram-negative bacteria.

Extract: Ethanolic and aqueous whole-plant extracts.

Concentration: Approximately **16–1025 mg/mL** in the MIC/MBC study.

Major finding

Ethanolic extract showed broader antibacterial activity than aqueous extract.

MIC values ranged from **16 mg/mL for *Salmonella typhi*** to **512.5 mg/mL for *Bacillus cereus* and *Staphylococcus aureus***.

Activity was observed against *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *E. coli* and other bacteria.

Mechanism — stepwise flowchart

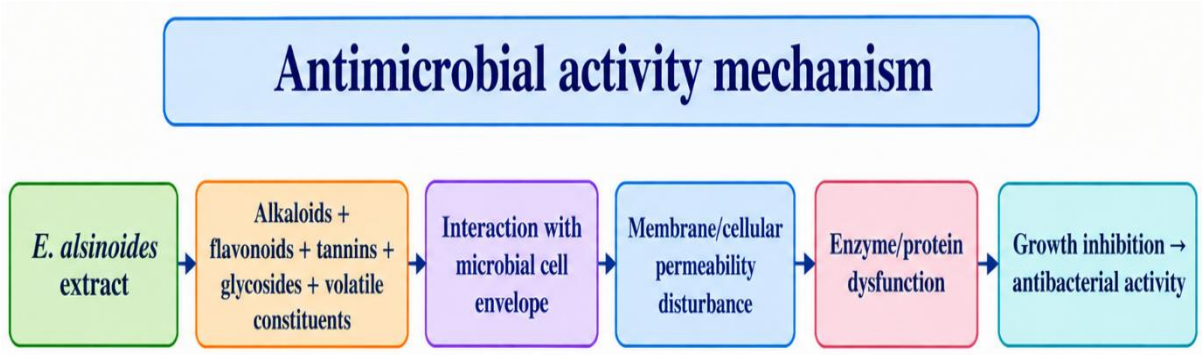


Fig 8: *Antimicrobial activity mechanism*.[55]

9. Antifungal activity

Experimental model: *Candida albicans* and *Aspergillus niger* in-vitro assays; recent compound-specific study against *C. albicans*.

Extract/compound: Methanolic extract; **umbelliferone isolated from *E. alsinoides***.

Concentration

Methanolic extract: **50, 100 and 150 µg/mL**.

Isolated umbelliferone: **1 mg** in the recent study.

MIC of umbelliferone: **125 µg/mL** against susceptible *C. albicans* and **175 µg/mL** against the multidrug-resistant strain.

Major finding

Methanolic extract inhibited *C. albicans* and *A. niger*.

Umbelliferone produced inhibition zones of approximately **16 and 14 mm** against susceptible and multidrug-resistant *C. albicans*, respectively.

Recent molecular studies indicated interaction with fungal DHFR and ERG11.

Mechanism — stepwise flowchart

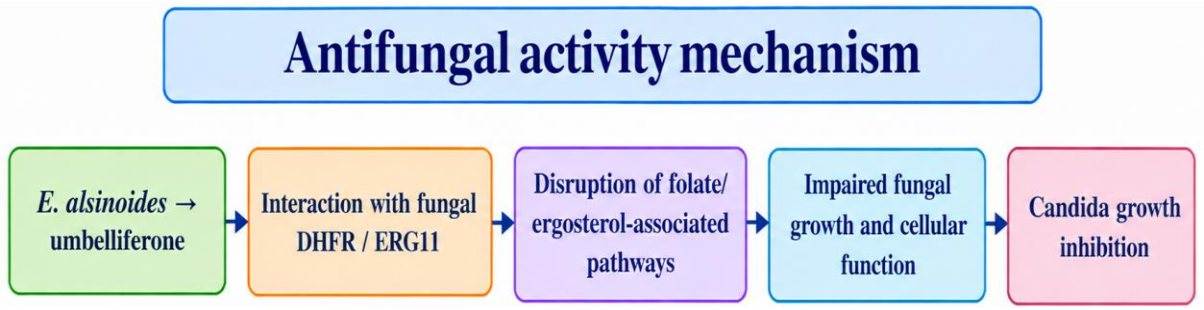


Fig 9: *Antifungal activity mechanism.* [56]

10. Antidiabetic activity

A. In-vitro enzyme inhibition

Experimental model: α-amylase and α-glucosidase inhibition assays.

Extract: Aqueous leaf extract.

Concentration: Up to **320 µg/mL**.

Major finding

- α-amylase inhibition reached approximately **70.68% at 320 µg/mL**.
- Methanolic/aqueous extracts also demonstrated α-amylase and α-glucosidase inhibitory activity.
- Caffeic acid showed favourable in-silico interaction with components of insulin-signalling pathways.

B. In-vivo diabetic model

Experimental model: Streptozotocin-induced diabetic rats.

Extract: Ethanolic whole-plant extract.

Dose: 150 mg/kg/day for 45 days.

Major finding

Improved insulin and C-peptide.

Improved pancreatic antioxidant enzymes.

Improved lipid abnormalities associated with diabetes.

Mechanism — flowchart

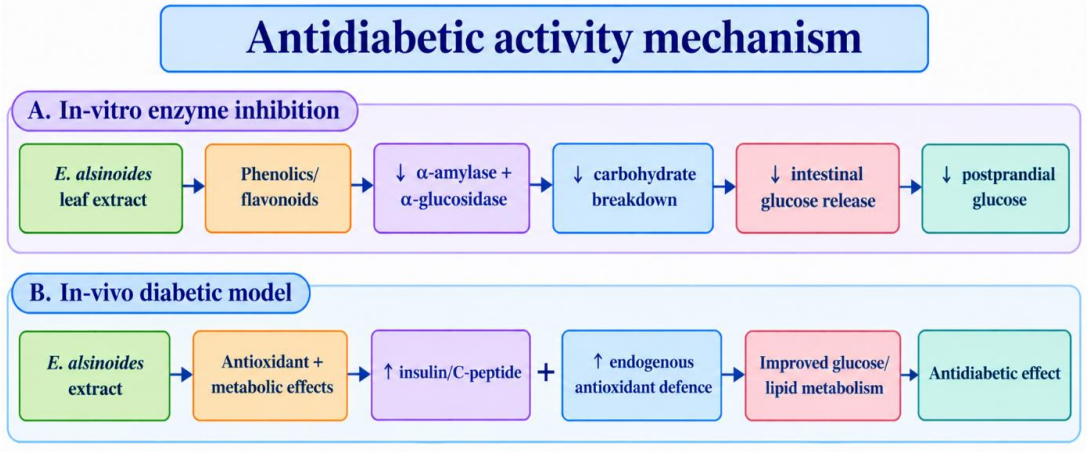


Fig 10: *Antidiabetic activity mechanism.*[57]

11. Immunomodulatory activity

Experimental model: Complete Freund's adjuvant-induced arthritis in rats.

Extract: Crude *E. alsinoides* extract.

Dose: Repeated intraperitoneal treatment; the original abstract does not provide the dose in the accessible PubMed record.

Major finding

Reduced paw inflammation and edema.

Reduced lymphocyte proliferative response.

Reduced synovial hyperplasia and inflammatory-cell infiltration.

Reduced induction of nitric oxide synthase (NOS).

Findings indicated an **immunosuppressive/immunomodulatory effect**.

Mechanism — flowchart

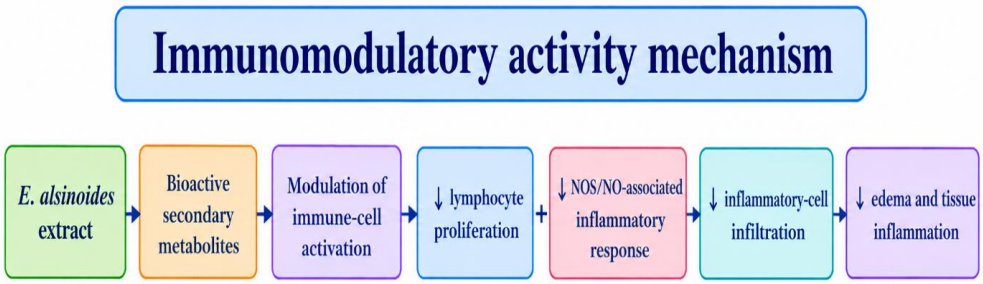


Fig 11: *Immunomodulatory activity mechanism.*[58]

12. Anti-inflammatory activity

Experimental model: Carrageenan- and formalin-induced paw edema in Wistar rats.

Extract: Chloroform and ethyl-acetate extracts of whole plant.

Dose: 200 and 400 mg/kg.

Major finding

Both extracts significantly reduced paw edema.

Ethyl-acetate extract showed the stronger activity.

At 120 min in the carrageenan model, approximately **27.4% and 28.3% protection** were reported for chloroform and ethyl-acetate extracts, respectively.

Mechanism — stepwise flowchart

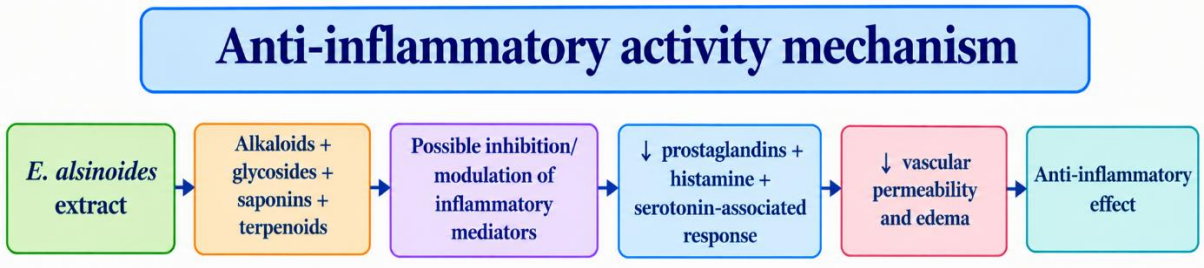


Fig 12: *Anti-inflammatory activity mechanism.*[59]

The original authors specifically discussed effects on prostaglandin, histamine and 5-HT-associated inflammatory responses; molecular COX/LOX confirmation would still be needed.

13.Wound-healing activity

Experimental model: Excision and incision wound models in rats.

Preparation: Alkaloid-enriched ointments and **betaine** isolated from aerial parts.

Dose/concentration: 50 mg/animal/day; AAO/BAO **1% and 2%**, betaine **0.5% and 1%**.

Major finding

Increased wound contraction.

Increased protein content.

Improved epithelization and neovascularization.

Improved skin-breaking strength.

Alkaloid-enriched preparations were more effective than betaine alone, suggesting possible synergism.

Mechanism— stepwise flowchart

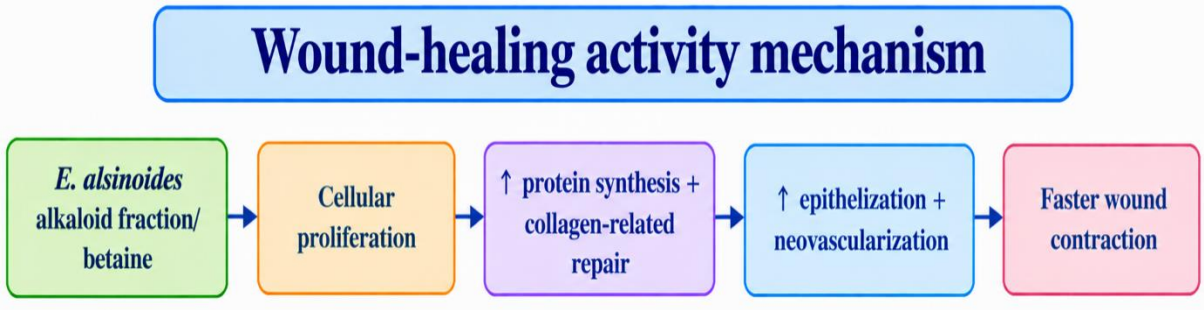


Fig 13: *Wound-healing activity mechanism.*[60]

14. Cardioprotective activity

Experimental model: Isoproterenol-induced myocardial infarction in rats.

Extract: Methanolic whole-plant extract.

Dose: 100 and 200 mg/kg.

Major finding

Reduced biochemical evidence of myocardial injury.

Improved endogenous antioxidant enzyme activity.

Reduced oxidative stress-associated cardiac damage.

Mechanism— stepwise flowchart

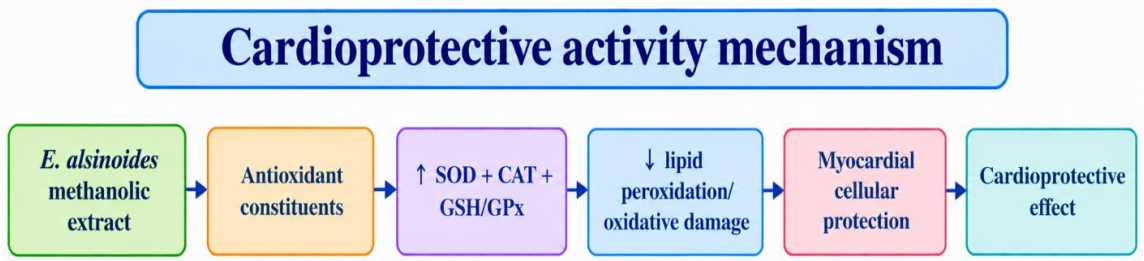


Fig 14: *Cardioprotective activity mechanism.*[61]

15. Gastroprotective/antiulcer activity

Experimental model: Experimental gastric-ulcer models in rats.

Preparation: Whole-plant powder/alcoholic extract.

Major finding

Gastroprotective and antiulcer effects have been reported in preclinical studies.

This activity supports some of the traditional gastrointestinal applications of the plant.

iMechanism— stepwise flowchart

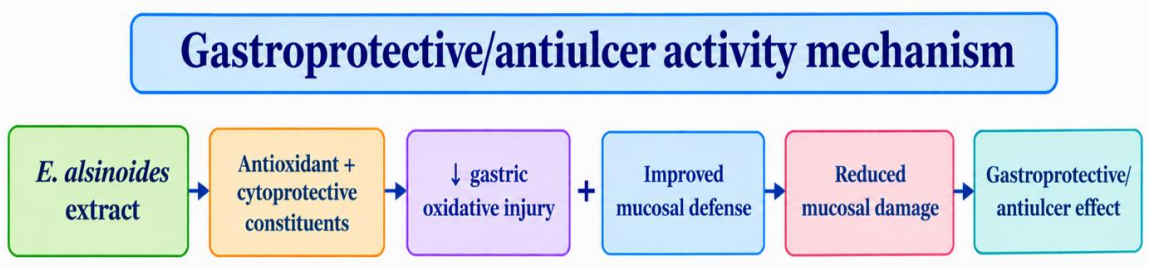


Fig 15: *Gastroprotective/antiulcer activity mechanism.*[62,63]

NEUROPHARMACOLOGICAL POTENTIAL OF *E. ASLINOIDES*

1. Cognitive Enhancement

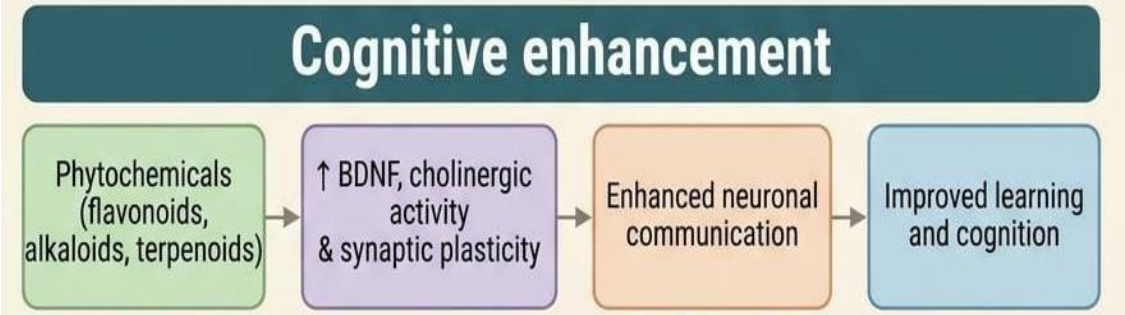


Fig 16: *Cognitive Enhancement.*[49]

↑ BDNF and acetylcholine levels

Enhances synaptic plasticity

Improves learning and attention

2. Memory Impairment

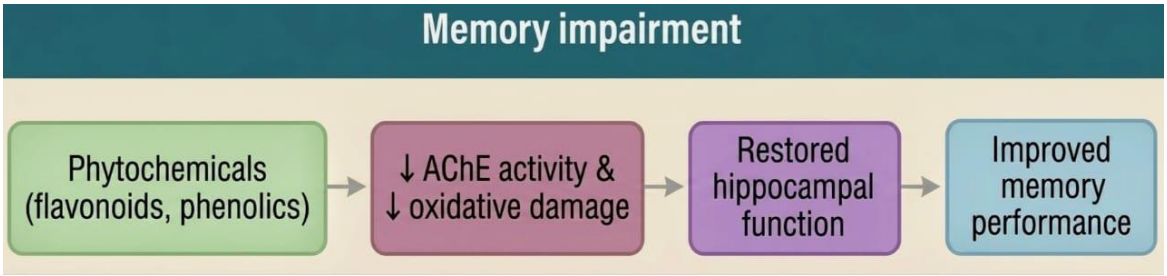


Fig 17: *Memory Impairment.*[12]

Inhibits AChE (↑ acetylcholine)

Reduces lipid peroxidation

Supports hippocampal neurons

3. Neuroprotection

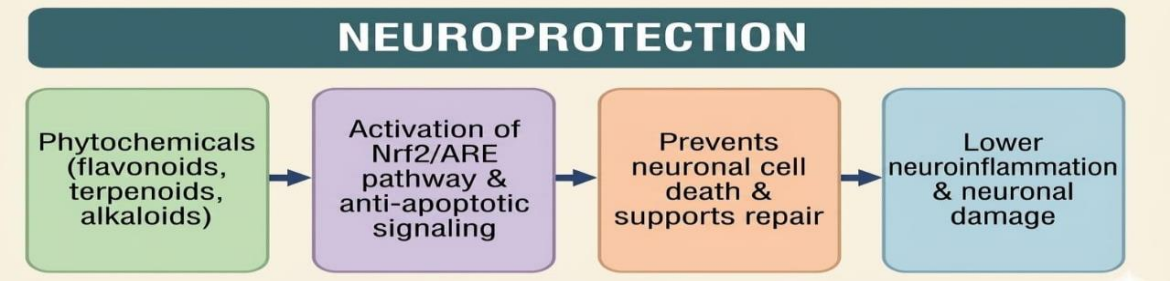


Fig 18: *Neuroprotection*.[10]

Activates antioxidant enzymes.

Inhibits caspase-mediated apoptosis.

Protects against ischemic & toxic injury.

4. Oxidative Stress

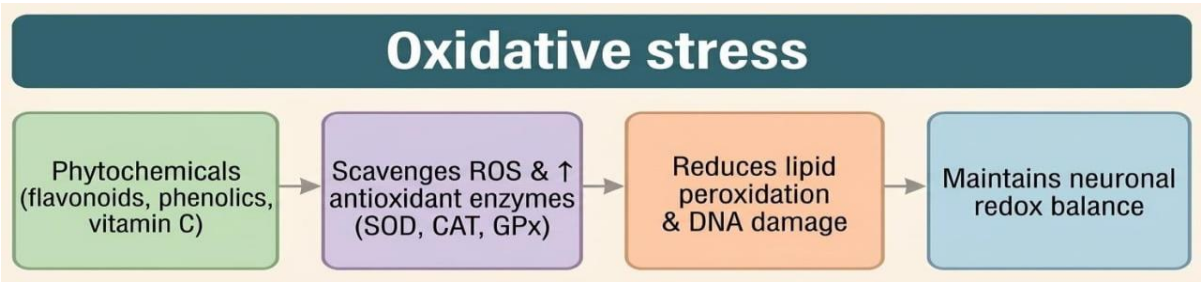


Fig 19: *Oxidative Stress*.[10,12]

Neutralizes free radicals

Increases SOD, CAT, GPX

5. Neuroinflammation

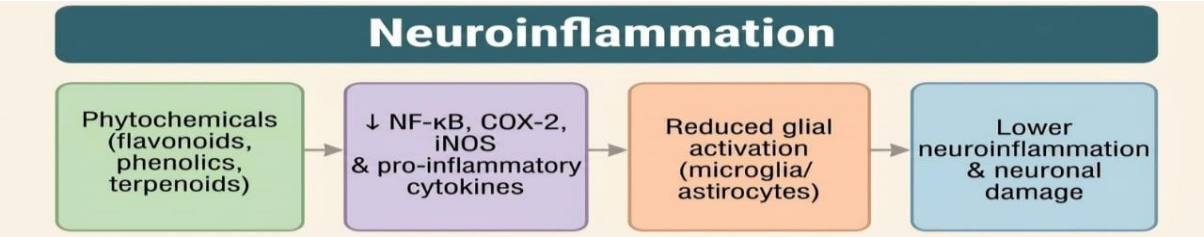


Fig 20: *Neuroinflammation*.[10]

Inhibits NF-kB signalling

Decreases TNF-a, IL-1B, IL-6

Reduces glial activation.

6. Depression and Anxiety

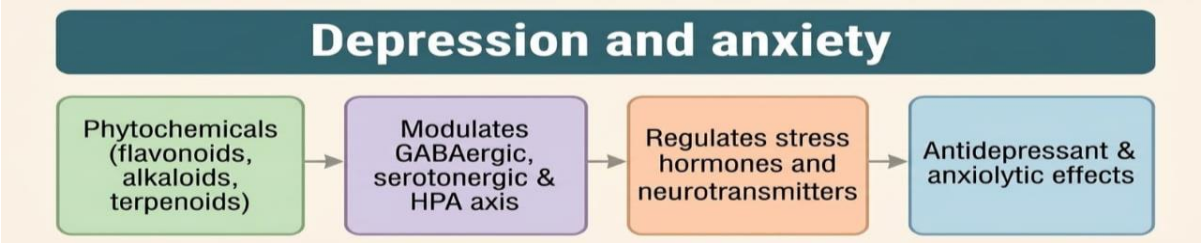


Fig 21: *Depression and Anxiety.*[64]

↑GABA, 5-HT levels

Balances HPA axis

Reduces stress and anxiety behaviour.

7. Epilepsy and Seizures

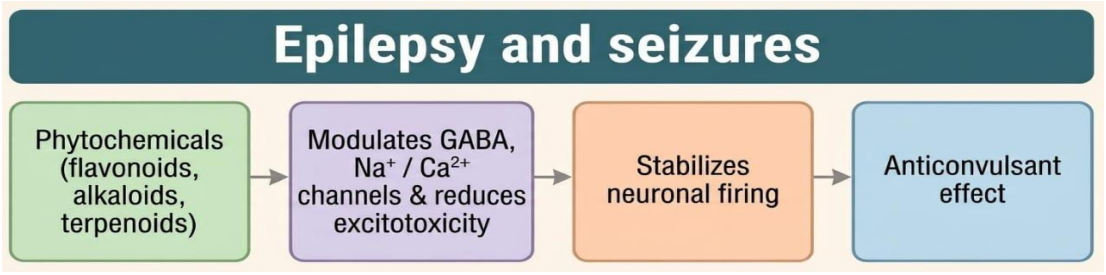


Fig 22: *Epilepsy and Seizures.*[65]

Enhances GABAergic transmission

Blocks voltage-gated channels

Reduces glutamate excitotoxicity.

RESEARCH GAP AND FUTURE PROSPECTS

1. CURRENT LIMITATIONS

Limited clinical evidence: Most evidence is preclinical; well-designed human clinical trials are still needed.[5]

Limited mechanistic studies: Reported pharmacological effects are not yet fully supported by detailed molecular mechanisms.[5]

Incomplete phytochemical characterization: Many constituents have been reported, but their individual biological roles require further confirmation.[5]

Lack of standardized extracts: Differences in extraction procedures and chemical profiles can affect biological activity.[66]

Variation in extraction methods: Different solvents produce different phytochemical profiles and concentrations.[66]

Identification of active compounds: Specific compounds responsible for major pharmacological effects need to be isolated and validated.

Limited pharmacokinetic information: Bioavailability, metabolism and systemic exposure of major constituents remain insufficiently investigated.[5]

Need for toxicity studies: More systematic acute, sub-chronic and chronic toxicity studies are required, particularly for long-term use.[5]

2. FUTURE RESEARCH

Bioactive compound isolation: Isolate and structurally characterize major active constituents.

Molecular mechanism studies: Investigate antioxidant, anti-inflammatory, cholinergic and neuroprotective pathways.

Standardized extracts: Develop chemically standardized extracts using validated marker compounds such as flavonoids or other suitable constituents.[67]

Advanced chromatographic analysis: Apply HPLC/HPTLC, GC–MS and LC–MS for accurate phytochemical profiling.[9]

Metabolomics: Use metabolomic approaches to identify biomarkers and compare extracts from different geographical or cultivation conditions.

Molecular docking: Predict interactions between identified phytochemicals and relevant therapeutic targets.

Network pharmacology: Explore multi-target interactions and possible synergistic mechanisms.

In-vivo validation: Confirm promising in-vitro and computational findings using appropriate animal models.

Clinical investigation: Progress from validated preclinical studies to properly designed human clinical trials.[5]

Sustainable cultivation: Develop reliable cultivation practices to ensure consistent and sustainable plant material.

Micropropagation: Tissue-culture methods can support rapid multiplication, genetic uniformity and year-round availability of quality plant material.[9]

CONCLUSION

Evolvulus alsinoides (L.) L., commonly known as Vishnukranta or Shankhpushpi, is a medicinal herb of the family *Convolvulaceae* with a long history of use in Ayurveda,

particularly as a Medhya Rasayana for memory and cognitive health. Phytochemical investigations have identified diverse classes of constituents, including flavonoids, phenolics, alkaloids, terpenoids, steroids, triterpenoids, saponins, glycosides, and fatty acids, with several individual compounds reported from different extracts.

Experimental studies indicate a broad pharmacological profile, including antioxidant, neuroprotective, memory-enhancing, anti-amnesic, anxiolytic, antidepressant, anti-inflammatory, antimicrobial, and immunomodulatory activities. Reported effects such as acetylcholinesterase inhibition may contribute to its potential cognitive effects. However, most evidence remains preclinical, and the contribution of individual constituents and molecular mechanisms is not yet fully established.

Overall, *E. alsinoides* represents a promising multicomponent natural resource for neuropharmacological and cognitive-health research. Its biological effects may depend on plant part, geographical origin, extraction method, and phytochemical composition, highlighting the need for standardized preparations. Future research should prioritize isolation and characterization of active constituents, chromatographic and metabolomic standardization, molecular and pharmacokinetic studies, dose-response evaluation, comprehensive toxicity assessment, sustainable cultivation, and well-designed clinical trials. Establishing reproducible efficacy, safety, dosing, and mechanisms will be essential for translating its traditional applications into evidence-based therapeutic use.

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