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A COMPENDIOUS REVIEW ON PHYTOPHARMACOLOGY OF *LANTANA CAMARA*

Ghanshyam Nirgude, Sarika Zingade*, Omkar Rankhamb, Sushma Wagatkar, Prashant Chavan, Sagar Pethkar, Hanuman Hendge

Department of Pharmaceutical Quality Assurance, Channabasweshwar Pharmacy College (Degree) Latur-413512, Maharashtra, India.

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***Corresponding Author: Sarika Zingade**
Department of Pharmaceutical Quality Assurance, Channabasweshwar Pharmacy College (Degree) Latur-413512, Maharashtra, India.
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ABSTRACT

Lantana camara L. (Verbenaceae) is a widely distributed perennial medicinal shrub recognized for its diverse phytochemical composition and broad spectrum of pharmacological activities. Although considered one of the world's most invasive plant species, it has been extensively utilized in traditional medicine for the treatment of wounds, skin diseases, fever, cough, inflammation, gastrointestinal disorders, rheumatic pain, and insect bites. The plant contains numerous bioactive constituents, including flavonoids, phenolic compounds, triterpenoids, alkaloids, tannins, saponins, steroids, glycosides, and essential oils. Important phytoconstituents such as quercetin, gallic acid, oleanolic acid, β-sitosterol, and caryophyllene contribute significantly to its therapeutic potential. Scientific investigations have demonstrated a variety of biological activities including antioxidant, antimicrobial, anti-inflammatory, wound-healing, analgesic, antipyretic, hepatoprotective, antidiabetic, anticancer, neuroprotective, and acetylcholinesterase (AChE) inhibitory effects. Particular attention has been directed toward its neuroprotective and AChE inhibitory properties, which suggest potential applications in the management of cognitive impairment and neurodegenerative disorders. This review compiles and critically summarizes the botanical characteristics, traditional uses, phytochemical profile, nutritional significance, and pharmacological activities of Lantana camara, highlighting its importance as a promising source of bioactive compounds for future pharmaceutical and therapeutic development.

KEYWORDS: *Lantana camara*, Verbenaceae, Phytochemistry, Flavonoids, Phenolic Compounds, Triterpenoids, Antioxidant Activity, Anti-inflammatory Activity, Acetylcholinesterase Inhibition, Neuroprotective Activity, Traditional Medicine, Pharmacological Activities.

INTRODUCTION:[1-9]

L*antana* c*amara* L. (family Verbenaceae) is a tropical, evergreen shrub native to the tropics of the Americas. It is a highly adaptable species capable of inhabiting a wide variety of ecosystems; once introduced into a habitat it spreads rapidly, thriving between 45°N and 45°S latitude and below 1,400 metres in altitude. Morphologically, it is a thorny, upright or semi-climbing shrub reaching 2–3 metres in height, with angular stems and branches bearing curved spines. The leaves are simple, opposite, and ovate with a rough lamina and regularly dentate margin. The inflorescence is a hemispherical, axillary or terminal head composed of numerous small tubular flowers, varying in colour from yellow and pink to orange. In terms of taxonomy, L. c*amara* is marked by significant variability, with a multitude of cultivars and hybrid varieties presenting challenges to its classification.[1-4]

Plants have long served as the foundation of traditional medicine and continue to be an indispensable source of novel bioactive compounds for modern drug discovery. The knowledge of traditional medicine and medicinal plants, studied through the lens of scientific chemical principles, may lead to the discovery of newer and cheaper drugs. Among the vast repertoire of medicinally important flora, L*antana* c*amara* L. stands out as a botanically complex and pharmacologically versatile species that has attracted sustained global research interest.[5-6]

Despite its ornamental appeal, L. c*amara* is listed in the IUCN's "List of the World's 100 Worst Invasive Species" and is considered a weed across large areas of the Paleotropics where it has established itself. It is distributed as an ornamental plant throughout the world since the 17th century and covers vast geographic zones - for instance, approximately 4 million hectares in Australia - where it forms dense, impenetrable thickets that replace indigenous vegetation and increase erosion. In India, L. c*amara* is found across numerous states including Maharashtra, Karnataka, Tamil Nadu, Kerala, Rajasthan, Uttar Pradesh, and the Andaman & Nicobar Islands, among others.[7]

The wide spectrum of pharmacological activities demonstrated by L. c*amara* extracts and isolated compounds is equally impressive. The plant boasts multiple pharmacological activities including antioxidant properties, antimicrobial activity, antibacterial and antifungal effects, antiulcerogenic traits, anthelmintic qualities, anti-hyperglycaemic features, anti-inflammatory benefits, analgesic effects, anticancer properties, antitubercular functions, and mosquito larvicidal activity. Recent investigations have further validated its potential as an anti-inflammatory agent: *in vitro* studies demonstrated that ethanolic extracts of L. c*amara* leaves inhibited protein denaturation with IC_{50} values of 202.27 and 223.85 ppm, respectively, and exhibited DPPH- and ABTS-scavenging antioxidant activity, warranting its further investigation as a candidate for complementary medicine.[8]

In recent decades, scientists and researchers around the globe have elaborately studied the chemical composition of the whole plant of L. c*amara*, as well as its biological and pharmacological activities. These studies have established the therapeutic potential of L*antana* c*amara* in modern medicine and positioned it as a promising candidate for drug discovery. Yet, despite this growing body of evidence, a comprehensive, consolidated account of its phytopharmacology remains essential to guide future translational research.[9]

Figure 1: Lantana Camara

Figure 2: Lantana Camara Leaf

Taxonomical Classification

Table 1: Taxonomical Classification of *pearl millet.*

Taxonomical Rank	**Taxon**
Domain	*Eukaryota*
Kingdom	*Plantae*
Phylum	*Magnoliophyta*
Sub-phylum	*Tracheophyta*
Tribe	*Lantaneae*
Class	*Magnoliopsida*
Order	*Lamiales*
Family	*Verbenaceae*
Sub-family	*Verbenoideae*
Genus	*Lantana* L.
Species	*Lantana camara* L.
Common Name	Common lantana, Wild sage, Red sage, Big sage Yellow sage, White sage, Shrub verbena Tickberry, West Indian lantana, Ghaneri (India) Putus (Bengal), Gu Phool (Assam)

Profile of the Plant

Habitat

Lantana camara L., a member of the family Verbenaceae, is a perennial, aromatic, evergreen shrub that generally grows between 1 and 4 meters in height, although under favorable environmental conditions it may reach up to 6 meters. The plant exhibits an erect or straggling growth habit and possesses quadrangular, hairy stems that are often armed with small prickles. Its leaves are arranged oppositely, ovate in shape, with serrated margins and a characteristic rough texture. The flowers are small, tubular, and borne in dense clusters (inflorescences), displaying a wide range of attractive colors including yellow, orange, pink, red, white, and various multicolored combinations. The fruits are fleshy berries that change from green to dark purple-black as they mature. *Lantana camara* is highly adaptable and drought-tolerant, enabling it to thrive in diverse environmental conditions. This remarkable adaptability contributes significantly to its widespread distribution and invasive nature in many tropical and subtropical regions.[10]

Distribution

Lantana camara is native to tropical regions of Central and South America but has become naturalized throughout tropical and subtropical regions worldwide.

It is widely distributed in India, Sri Lanka ,Nepal ,Bangladesh ,Pakistan ,Australia ,South Africa ,Kenya ,Brazil, Tropical and subtropical regions of Asia, Africa, and Oceania.

In India, L*antana* c*amara* is commonly found along roadsides, forest margins, wastelands, agricultural fields, grasslands, hill slopes, and disturbed habitats from sea level up to about 2,000 m altitude.[11]

BOTANICAL DESCRIPTION:[12-16]

Rough, aromatic leaves with serrated margins, Small, colourful flowers arranged in compact clusters, Woody, branched stem with small prickles, Black berry-like fruits when mature. Characteristic pungent smell from crushed leaves.

Habit:- Lantana camara L. is a perennial, aromatic, evergreen shrub belonging to the family Verbenaceae. It usually grows to a height of 1–4 m and forms dense thickets in tropical and subtropical regions. The plant is often branched and may exhibit a scrambling or climbing habit under favourable conditions.

Root:- The root system is well-developed, woody, and branched with a strong taproot accompanied by numerous lateral roots. The extensive root system contributes to the plant's drought tolerance and invasive nature.

Stem:- The stem is erect, quadrangular (four-angled) when young, becoming cylindrical and woody with age. It is rough, covered with small prickles or hairs, and exhibits extensive branching. Young stems are green, while mature stems become brown and lignified.

Leaf:- Leaves are simple, opposite, petiolate, and ovate to broadly ovate in shape, measuring approximately 2–10 cm in length and 2–6 cm in width. The leaf apex is acute, the margin is serrated or crenate-serrate, and the base is rounded to subcordate. The upper surface is dark green and rough, while the lower surface is lighter green and pubescent. Leaves emit a characteristic pungent odour when crushed due to the presence of essential oils**.**

Inflorescence:- The inflorescence is a dense, axillary, capitate head borne on a long peduncle. Each flower head contains numerous small tubular flowers. Flower color varies from yellow, orange, pink, red, white, or multi-coloured, often changing color with age.

Vernacular Name

Table 2: Vernacular names of L*antana* C*amara.*

Language	**Name**
English	Wild Sage, Common Lantana, Tick-berry
Marathi	Ghaneri (घाणेरी)
Hindi	Raimuniya, Panchphuli
Tamil	Unni Chedi
Telugu	Puli Kampa
Kannada	Kakke Hoovu
Malayalam	Alipova

AYURVEDA PROPERTIES:[17 – 19]

Table 3: Ayurveda properties of L*antana* C*amara*

Ras	Tikta (Bitter), Katu (Pungent)
Vipak	Katu (Pungent)
Veerya (potency)	Ushna (Hot)
Guna	Laghu (Light), Ruksha (Dry)
Karma	Krimighna (Antimicrobial/Anthelmintic), Shothahara (Anti-inflammatory), Vrana Shodhana (Wound cleansing), Vrana Ropana (Wound healing), Kandughna (Anti-pruritic), Jvaraghna (Antipyretic, traditionally reported)

Effect on dosha	Helps reduce Kapha and Vata; excessive use may aggravate Pitta
Effect on dhatu	body tissues

NUTRITIONAL POTENTIAL[20-22]

Lantana camara has notable nutritional and pharmaceutical value due to its rich chemical composition. The leaves contain appreciable amounts of protein and dietary Fiber, along with flavonoids and phenolic compounds that contribute to antioxidant and neuroprotective activities. However, its use as a food source is limited by the presence of anti-nutritional constituents such as tannins, oxalates, phytates, and lantadenes. For pharmaceutical research, flavonoids, phenolic acids, and triterpenoids are the most significant bioactive compounds because of their antioxidant, anti-inflammatory, neuroprotective and acetylcholinesterase (AChE) inhibitory properties, making the plant a promising candidate for memory enhancement and neurodegenerative disorder studies.

TRADITIONAL USES:[23-25]

Wound healing (Vrana Ropana) ,Treatment of skin diseases, Management of fever, Relief from cough and cold, Anti-inflammatory applications ,Antimicrobial treatment,Treatment of gastrointestinal disorders, Management of rheumatic pain, Insect repellent and treatment of insect bites.

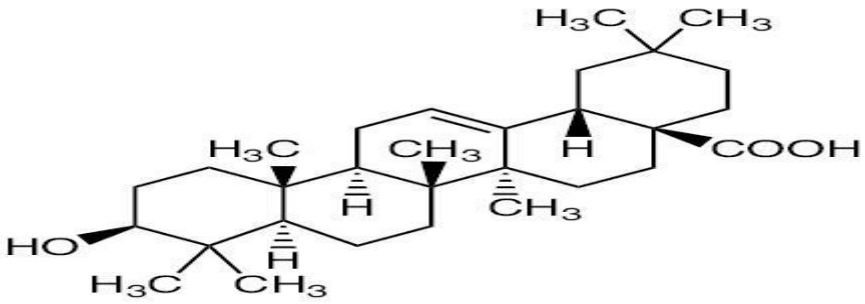
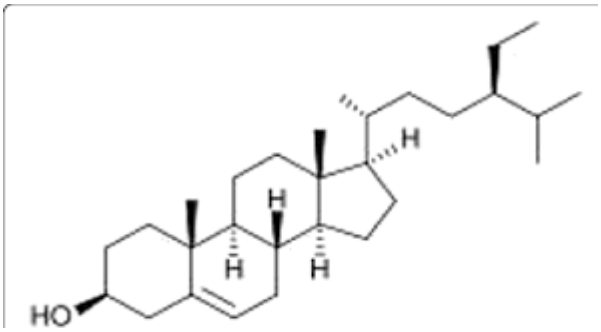
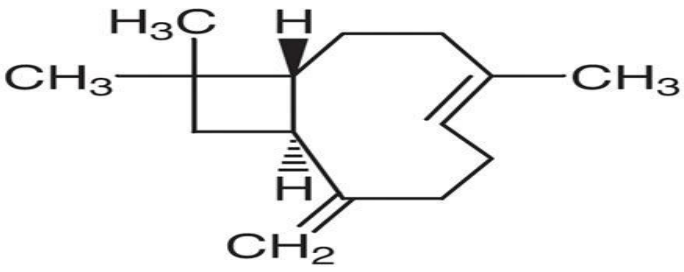
PHYTOCHEMISTRY:[25-27]

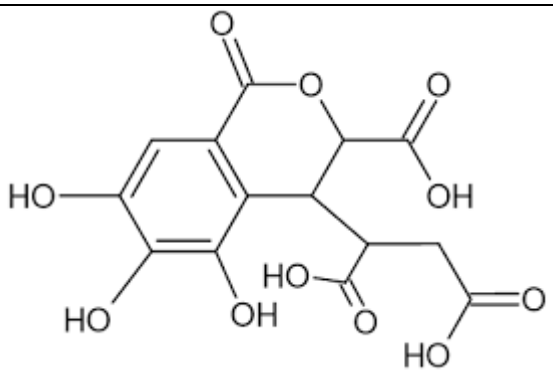
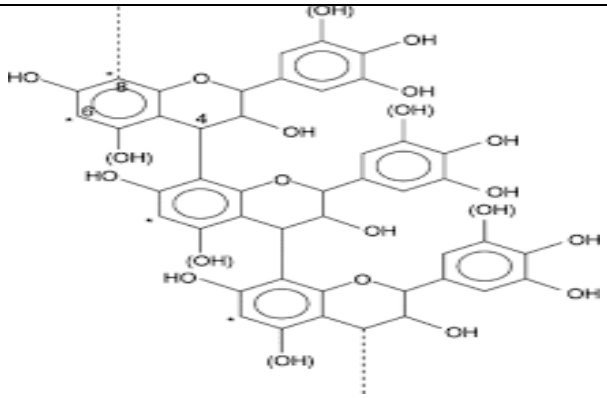
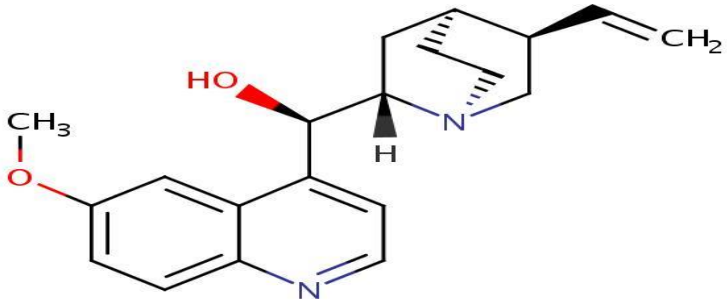
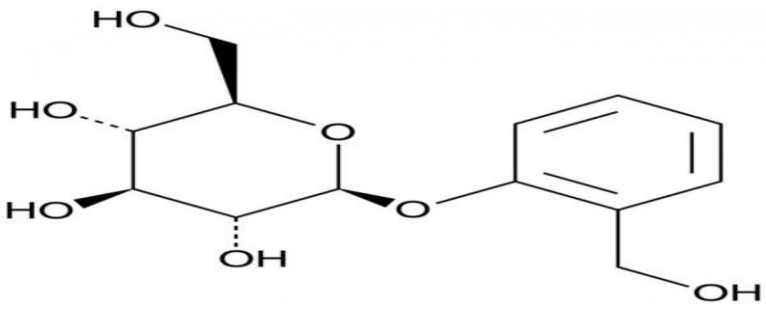
L*antana camara* L. (Family:-Verbenaceae) is a rich source of diverse phytochemicals that contribute to its medicinal and pharmacological properties. The plant contains several classes of secondary metabolites, including flavonoids, phenolic compounds, triterpenoids, alkaloids, saponins, tannins, steroids, glycosides, and essential oils. Among the flavonoids, quercetin, kaempferol, luteolin, and apigenin have been reported and are known for their antioxidant and neuroprotective activities. Phenolic compounds such as gallic acid, caffeic acid, chlorogenic acid, and ferulic acid contribute significantly to the plant's free-radical scavenging and antioxidant potential. The triterpenoid fraction contains important compounds such as oleanolic acid, ursolic acid, lantadene A, and lantadene B, which exhibit anti-inflammatory, antimicrobial, and various other biological activities.

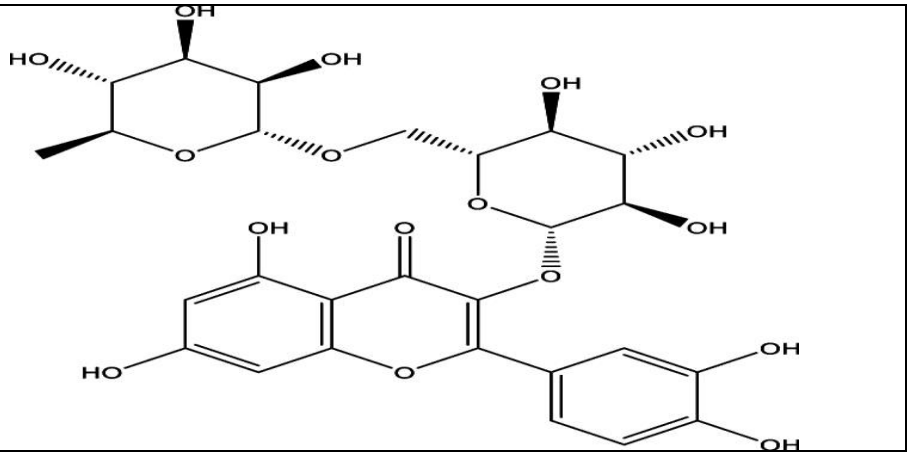
In addition to these major constituents, L*antana camara* contains tannins, saponins, steroids (β-sitosterol and stigmasterol), and volatile essential oils rich in caryophyllene, germacrene-D, α-pinene, and β-pinene. These phytochemicals collectively contribute to the plant's antimicrobial, wound-healing, insecticidal, anti-inflammatory, and antioxidant properties. Recent studies have also highlighted the potential neuroprotective and acetylcholinesterase (AChE) inhibitory activities of some of these compounds, supporting the use of L*antana camara* in memory-enhancement research. For phytochemical standardization and fingerprinting studies, marker compounds such as quercetin (flavonoid), gallic acid (phenolic acid), and oleanolic acid (triterpenoid) are frequently selected because they represent the major bioactive classes present in the plant and can be accurately quantified using HPTLC and other chromatographic techniques.

Table 4: Name of phytoconstituents and structure[27-28]

Sr. No	Name of compound	Structure
1	Quercetin	O / \ HO--| |--OH ___/

		O---C---C6H3(OH)2 \ / C / \ OH OH
2	Gallic Acid	COOH | HO---|---OH | OH
3	Oleanolic Acid	
4	β-Sitosterol	
5	Caryophyllene	

6	Hydrolysable Tannins	
7	Condensed Tannins.	
7	Alkaloids (Quinine)	
8	Phenolic and Flavonoid Glycosides	

9	Flavonoid Glycosides	

PHARMACOLOGICAL ACTIONS:[28-29]

Table 5: Pharmacological actions of L*antana* C*amara.*

Plant Part	Pharmacological Activity	Reported Effect
Leaves	Antioxidant	Scavenges free radicals and reduces oxidative stress
Leaves	Acetylcholinesterase (AChE) Inhibitory	Potential memory-enhancing and neuroprotective activity
Leaves	Anti-inflammatory	Reduces inflammation and swelling
Leaves	Antimicrobial	Active against various bacteria and fungi
Leaves	Wound Healing	Promotes tissue repair and wound contraction
Leaves	Antipyretic	Helps reduce fever
Leaves	Analgesic	Relieves pain
Leaves	Insecticidal	Effective against insects and mosquito larvae
Leaves	Cytotoxic/Anticancer	Shows activity against certain cancer cell lines
Leaves	Hepatoprotective	Protects liver cells from oxidative damage
Flowers	Antioxidant	Rich in phenolic compounds with free-radical scavenging activity
Flowers	Antimicrobial	Inhibits microbial growth
Flowers	Anti-inflammatory	Reduces inflammatory responses
Roots	Antimalarial	Traditionally used against malaria
Roots	Antimicrobial	Effective against bacterial infections
Roots	Anti-inflammatory	Used in rheumatism and painful conditions
Roots	Antipyretic	Traditionally used to manage fever
Stem Bark	Antimicrobial	Exhibits antibacterial and antifungal activity
Stem Bark	Anti-inflammatory	Helps reduce inflammation
Essential Oil	Antimicrobial	Active against pathogenic microorganisms
Essential Oil	Insecticidal	Repels insects and controls pests
Essential Oil	Larvicidal	Effective against mosquito larvae
Whole Plant	Antioxidant	Protects against oxidative damage
Whole Plant	Antimicrobial	Broad-spectrum antimicrobial activity
Whole Plant	Anti-inflammatory	Reduces inflammation
Whole Plant	Immunomodulatory	May modulate immune responses
Whole Plant	Antidiabetic	Reported to help regulate blood glucose levels
Whole Plant	Neuroprotective	Potential protective effect on neuronal cells

Pharmacological Activities Relevant to "Multi-Marker HPTLC Fingerprinting of *Lantana camara* Leaves with AChE Correlation"[30-32]

1. Acetylcholinesterase (AChE) Inhibitory Activity

Acetylcholinesterase (AChE) is an enzyme responsible for the hydrolysis of the neurotransmitter acetylcholine at cholinergic synapses. In neurodegenerative disorders such as Alzheimer's Disease, a decrease in acetylcholine levels is associated with impaired memory and cognitive function. Inhibition of AChE increases the concentration of

acetylcholine in the synaptic cleft, thereby improving cholinergic neurotransmission and cognitive performance. *Lantana camara* leaves contain flavonoids, phenolic acids, and triterpenoids that may contribute to AChE inhibition. Compounds such as quercetin and gallic acid have been reported to interact with the active site of the enzyme, resulting in reduced enzymatic activity. Therefore, evaluating the correlation between marker compounds and AChE inhibitory activity can help identify phytochemicals responsible for the memory-enhancing potential of the plant.

2. Neuroprotective Activity

Neuroprotection refers to the ability of a substance to preserve neuronal structure and function against damage caused by oxidative stress, inflammation, excitotoxicity, and aging. The phytoconstituents present in *Lantana camara*, particularly flavonoids and phenolic compounds, exhibit neuroprotective properties through multiple mechanisms. These compounds can reduce neuronal damage by scavenging reactive oxygen species, inhibiting neuroinflammation, and protecting neuronal membranes from oxidative injury. Neuroprotective activity is particularly important in conditions involving cognitive decline and neurodegeneration. The potential of *Lantana camara* to protect neuronal cells supports its investigation as a natural source of compounds useful for memory enhancement and brain health.

3. Antioxidant Activity

Oxidative stress results from an imbalance between the production of reactive oxygen species (ROS) and the body's antioxidant defense system. Excessive ROS can damage proteins, lipids, and DNA, leading to cellular dysfunction and neuronal degeneration. L*antana c*a*mara* is rich in antioxidant phytochemicals, including quercetin, gallic acid, caffeic acid, and other phenolic compounds. These molecules donate electrons or hydrogen atoms to neutralize free radicals and prevent oxidative damage. Antioxidant activity is particularly relevant in neurodegenerative disorders because oxidative stress plays a major role in neuronal loss and memory impairment. The antioxidant potential of *Lantana camara* may therefore contribute significantly to its neuroprotective and cognition-enhancing effects.

4. Anti-inflammatory Activity

Inflammation is a biological response to injury, infection, or cellular stress. Chronic inflammation in the central nervous system can contribute to neuronal dysfunction and neurodegenerative diseases. *Lantana camara* contains bioactive compounds such as oleanolic acid, ursolic acid, flavonoids, and phenolic acids that possess anti-inflammatory properties. These compounds can inhibit the production of pro-inflammatory mediators and cytokines, thereby reducing inflammatory responses. By suppressing neuroinflammation and protecting neuronal tissue from inflammatory damage, the plant may help preserve cognitive function and support brain health. The anti-inflammatory activity also complements the antioxidant and neuroprotective actions of the plant, making it a promising candidate for studies related to memory enhancement.

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