# Evaluation and Pharmacological Comparison of *Jatropha integerrima* and *Evolvulus nummularius*: A Comprehensive Review

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# ABSTRACT

*Jatropha integerrima* and *Evolvulus nummularius* are two medicinal plants with distinct pharmacological profiles. *Jatropha integerrima* is renowned for its potent anti-inflammatory, antimicrobial, and antioxidant properties, making it a promising candidate for treating inflammatory conditions and infections. Conversely, *Evolvulus nummularius* exhibits strong neuroprotective, nootropic, and anxiolytic activities, with potential applications in neurodegenerative disorders such as Alzheimer's and Parkinson's disease. This review comprehensively evaluates their pharmacological efficacy, safety, and therapeutic potential by analyzing available scientific literature. While both plants demonstrate low toxicity at therapeutic doses, caution is advised for prolonged use due to potential cytotoxic effects observed in high-dose studies. The comparative analysis highlights their unique medicinal contributions and underscores the need for further clinical studies to validate their efficacy and safety.

# Keywords

*Jatropha integerrima*, *Evolvulus nummularius*, neuroprotection, anti-inflammatory, antimicrobial, cognitive enhancement, phytopharmacology, medicinal plants

## **GRAPHICAL ABSTRACT**



# INTRODUCTION

Medicinal plants have been an integral part of traditional medicine systems worldwide, offering a rich source of bioactive compounds with therapeutic potential. Among such plants, *Jatropha integerrima* and *Evolvulus nummularius* stand out due to their diverse pharmacological properties and traditional applications. *Jatropha integerrima*, belonging to the Euphorbiaceae family, is a tropical shrub native to the West Indies and widely cultivated in South Asia. It has been traditionally used for its purgative, styptic, and anti-inflammatory properties and has shown promising biological activities such as anticancer, antimicrobial, and anti-inflammatory effects.<sup>1,2</sup> On the other hand, *Evolvulus nummularius*, a member of the Convolvulaceae family, is known for its wound-healing, antibacterial, and antioxidant properties. This plant has been traditionally used to treat burns, wounds, and scorpion stings due to its rich phytochemical composition, including  $\beta$ -sitosterol, ursolic acid, and stigmasterol.<sup>3, 4</sup>

## **BOTANICAL DESCRIPTION**

## Jatropha integerrima Jacq. (Euphorbiaceae)

*Jatropha integerrima* is an evergreen shrub or small tree, reaching heights of 4.6–5 meters (15–16.4 feet) with a dense, multi-trunked structure. Its stems are dark brown, striated, and produce a milky sap that is toxic if ingested. Native to Cuba and the West Indies, it is naturalized in tropical regions of Asia, Africa, and the Americas. It thrives in well-drained soils under full sun and is drought-tolerant. The leaves are oblong to obovate, up to 15.3 cm long and 12.5 cm wide, with a glossy green upper surface and purple-flecked underside. Young leaves exhibit a bronze coloration. Clusters of star-shaped, deep red (or occasionally pink) flowers (1–2.5 cm wide) bloom year-round, attracting pollinators such as butterflies and hummingbirds. Each flower has five petals and prominent yellow stamens. The plant produces egg-shaped, explosively dehiscent capsules (~1.3 cm long) containing cream-colored seeds mottled with red and black spots.<sup>5-7</sup>

## Evolvulus nummularius (L.) L. (Convolvulaceae)

A low-growing, creeping perennial herb with stems that root at nodes. It forms dense mats and grows up to 2 cm tall, with slightly pubescent, woody stems. Leaves are alternate, ovate to orbicular (1–2 cm long and 0.8–1.8 cm wide), with cordate bases and emarginate apices. The surfaces are sparsely pubescent. Solitary, actinomorphic white flowers (6–8 mm wide) arise from leaf axils. Each flower has five fused petals, five functional stamens, and a campanulate corolla. Flowering occurs year-round. The fruit is a round, many-seeded capsule (~2 mm diameter) containing brown or black seeds. Native to tropical America, it has naturalized globally in disturbed habitats, including rocky soils and roadsides. It is widespread in the Caribbean, Central/South America, and parts of Asia.<sup>8, 9</sup>

Feature	Jatropha integerrima	Evolvulus nummularius	
Growth Form	Shrub/small tree	Creeping herb	
Leaf Size	Up to 15.3 cm long	1–2 cm long	
Flower Color	Red or pink	White	
Toxicity	All parts poisonous	Non-toxic (no reported medicinal use)	
Native Range	Caribbean, West Indies	Tropical America	

Table 1: Botanical description of Jatropha integerrima & Evolvulus nummularius plants

## PHYTOCHEMICAL COMPOSITION

#### Jatropha integerrima

#### **Major Compounds:**

The plant contains a diverse array of bioactive compounds, including flavonoids such as C-glycosides (e.g., vitexin, isovitexin, and isoorientin) and apigenin derivatives. Terpenoids are also prominent, with diterpenes (e.g., *jatrophone, integerrimine*) and sesquiterpenes being the most abundant, alongside triterpenes like stigmasterol. Phenolic compounds are present in the form of phenolic acid conjugates, coumarins (e.g., fraxitin, scopeltin), and lignans. Additionally, alkaloids have been detected in excretory idioblasts and laticifers throughout the plant's organs.<sup>2, 10-12</sup>

## **Bioactive Constituents**:

The plant exhibits a rich chemical profile, including integerrimine, a macrocyclic diterpene with a unique 8, 9seco-rhamnofolane skeleton, and jatrophone, a cytotoxic macrocyclic diterpene. Lignans and coumarins, identified in stem bark and leaves, contribute to antioxidant and anti-inflammatory effects, while eight cyclic peptides annotated in leaf extracts are linked to anti-inflammatory activity. Key findings reveal that leaf extracts contain 133 metabolites, including 24 diterpenoids and 19 flavonoids. Essential oils from leaves and seeds are notably rich in pentadecanal (32.4%) and monoterpenes such as 1,8-cineole and  $\alpha$ -pinene. Histochemical analysis further confirms the presence of terpenoids, alkaloids, and phenolics in secretory cavities and laticifers. 2,10,11,13

#### Evolvulus nummularius

#### **Major Compounds:**

The plant contains a variety of bioactive compounds, including scopoletin, a coumarin derivative known for its antioxidant and radical-scavenging properties, alongside other coumarins and phenolic compounds that contribute to antimicrobial and anti-inflammatory activities. Flavonoids, such as quercetin derivatives, are also present, exhibiting antioxidative and anti-inflammatory effects. Additionally, glycosides, detected in phytochemical screenings, enhance the plant's bioactivity and therapeutic potential

### **Bioactive Constituents:**

The plant *Evolvulus nummularius* contains bioactive compounds such as evolvine, an alkaloid contributing to its pharmacological profile, including antimicrobial activity, and nummulariin, which exhibits antioxidant and wound-healing properties. Key findings highlight that methanol extracts of the plant demonstrate significant antibacterial activity against both Gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli, Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*), with minimum inhibitory concentrations (MICs) ranging from 3.125 to 12.5 mg/mL. Flavonoids in the plant further inhibit inflammatory enzymes like cyclooxygenase (COX) and lipoxygenase (LOX), reducing the production of prostaglandins and leukotrienes, which supports its traditional use in wound care.<sup>3,4</sup>

## **PHARMACOLOGICAL ACTIVITIES**

#### **Antioxidant Activity**

Both *Jatropha integerrima* and *Evolvulus nummularius* exhibit significant antioxidant properties, primarily attributed to their high phenolic and flavonoid content. These compounds neutralize free radicals, reduce oxidative stress, and protect cellular components from damage.

## Jatropha integerrima:

Flower extracts demonstrated potent antioxidant activity, with 79.63  $\pm$  0.42% DPPH radical scavenging at 25 µg/mL and a FRAP value of 1427  $\pm$  9.61 µmol Trolox/100 g, outperforming synthetic antioxidants like BHA. Isoorientin (a flavonoid) and vitexin (a flavone glycoside) were identified as major contributors to antioxidant effects through UPLC/ESI-qTOF-HRMS/MS analysis.<sup>12</sup> Comparative studies of Jatropha species ranked *J. integerrima* third in antioxidant activity (88.3% DPPH scavenging) after *J. gossypifolia* and *J. curcas.*<sup>14</sup> Ultrasound-assisted extraction (UAE) optimized with ethanol (59.6%) and a solvent/material ratio of 50:1 yielded 1103.38  $\pm$  16.11 µmol Trolox/g dry weight, surpassing traditional methods in efficiency.<sup>15</sup>

#### Evolvulus nummularius:

The methanol extract exhibited free radical scavenging activity using the DPPH assay, with an  $IC_{50}$  value of  $350\mu$ g/mL. The activity was attributed to phytochemicals like tannins, flavonoids, and triterpenoids, which

are known for their antioxidant and anti-inflammatory properties. The scavenging activity increased with concentration but was lower than the control (ascorbic acid).<sup>4</sup>

Table 2: Antioxidant	description o	of Jatropha	integerrima &	Evolvulus	nummularius	plants
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Plant	Key Antioxidant Compounds	Activity Highlights
Jatropha integerrima	Isoorientin, vitexin, phenolic acids	FRAP: 1427 μmol Trolox/100 g; UAE efficiency: 1103 μmol/g DW
Evolvulus nummularius	Scopoletin, flavonoids, tannins	IC <sub>50</sub> DPPH: 350 μg/mL; antibacterial synergy

## Anti-Inflammatory Activity of Jatropha integerrima

*Jatropha integerrima* Jacq., belonging to the Euphorbiaceae family, is widely distributed in tropical and subtropical regions, including South America, West Africa, India, and Southeast Asia. Traditionally, this plant has been used for its therapeutic benefits, including the treatment of various inflammatory conditions, skin disorders, and as a wound-healing agent. Recent scientific investigations have highlighted the significant anti-inflammatory properties of *Jatropha integerrima*, both in oral and topical applications.

The leaves and flowers of *Jatropha integerrima* contain a rich array of bioactive compounds, including flavonoids, diterpenoids, phenolic acids, cyclic peptides, and coumarins. These compounds contribute to the anti-inflammatory effects observed in experimental models. Oral administration of *Jatropha integerrima* leaves extract (JILE) at doses of 200 mg/kg and 400 mg/kg demonstrated marked inhibition of inflammation in a carrageenan-induced paw edema model in rats, achieving edema reduction comparable to the standard drug indomethacin. Similarly, topical application of JILE cream (10%) significantly inhibited edema and normalized inflammatory biomarkers, outperforming hydrocortisone in some cases. The anti-inflammatory effect was associated with decreased levels of nitric oxide (NO), prostaglandin E2 (PGE2), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), and protein kinase C (PKC), indicating its potential in modulating inflammatory pathways.<sup>2</sup>

Moreover, the methanolic extract of *Jatropha integerrima* flowers exhibited strong anti-inflammatory activity through albumin denaturation inhibition and heat-induced hemolysis assays. The extract also demonstrated potent antioxidant properties, including DPPH radical scavenging, ferric reducing antioxidant power (FRAP), and hydrogen peroxide scavenging. These antioxidant effects further support its anti-inflammatory potential by mitigating oxidative stress, which often contributes to inflammation.<sup>16</sup>

The metabolite profiling of *Jatropha integerrima* identified 133 bioactive compounds, including vitexin, isovitexin, stigmasterol, and diterpenoidal derivatives, which are known for their anti-inflammatory activities. These findings emphasize the potential of *Jatropha integerrima* as a promising natural source for developing anti-inflammatory therapeutic agents. Further investigations are warranted to explore its clinical applications and safety profile.



Figure 1: Jatropha integerrima mechanism of action and antioxidant properties

## Anti-Inflammatory Activity of Evolvulus nummularius

The anti-inflammatory potential of *Evolvulus nummularius* has been investigated through both in vitro and in vivo studies. The primary mechanism underlying its anti-inflammatory activity involves the inhibition of cyclooxygenase (COX) enzymes, particularly COX-2, which is responsible for the biosynthesis of proinflammatory prostaglandins such as PGE2. COX-2 is inducible and upregulated during inflammatory responses, whereas COX-1 is constitutively expressed and involved in maintaining normal physiological functions. Furthermore, experimental studies have demonstrated the significant inhibitory effects of *Evolvulus nummularius* on COX-2 activity, with ethanol extracts showing more pronounced effects than aqueous or hexane extracts. The extract also exhibited potent free radical scavenging activity, as indicated by its ability to reduce DPPH and hydroxyl radicals, suggesting its dual role as an anti-inflammatory and antioxidant agents. The in vivo anti-inflammatory activity of *Evolvulus nummularius* was assessed using carrageenan-induced paw edema and PMA-induced mouse ear edema models. Results indicated a marked reduction in paw volume and ear swelling, which was comparable to standard anti-inflammatory drugs like indomethacin. The plant's efficacy in reducing edema and suppressing inflammatory markers makes it a promising candidate for natural anti-inflammatory therapy.<sup>17</sup>

Phytochemical screening of *Evolvulus nummularius* extracts has revealed the presence of flavonoids, which play a key role in modulating inflammation. Flavonoids like quercetin and rutin are known to inhibit the NF- $\kappa$ B pathway, reducing the expression of pro-inflammatory cytokines, such as TNF- $\alpha$  and IL-6. They also suppress the production of reactive oxygen species (ROS) and downregulate the expression of COX-2, thus mitigating inflammation and oxidative stress.<sup>18</sup>



Figure 2: Evolvulus nummularius mechanism of action and antioxidant properties

## Antimicrobial Activity of Jatropha integerrima

Several studies have demonstrated the antimicrobial potential of Jatropha species, including *Jatropha curcas* and *Jatropha sp*. The latex of Jatropha species exhibits significant antibacterial activity against methicillinresistant *Staphylococcus aureus* (MRSA), extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli*, *Klebsiella pneumoniae*, and carbapenemase-resistant *Pseudomonas aeruginosa* (CRPA). The latex demonstrated inhibition zones ranging from 20.4 to 23.7 mm against MRSA and 12 to 15 mm against CRPA. The minimum inhibitory concentration (MIC) values ranged from 0.19% to 6.25% for MRSA and 25% for CRPA, while the minimum bactericidal concentration (MBC) was found to be between 0.93% and 12.5%.<sup>19</sup>

Moreover, the ethanolic leaf extract (ELJC) and stem bark latex (LJC) of *Jatropha curcas* demonstrated significant antimicrobial effects against oral microorganisms, including *Streptococcus sanguinis*, *Streptococcus mutans*, *Streptococcus mitis*, *Lactobacillus helveticus*, *Candida albicans*, *and Candida tropicalis*. ELJC and LJC exhibited morphological changes and increased death rates in the targeted microorganisms, indicating their potential as antimicrobial agents.<sup>20</sup>

Furthermore, the seed extract of *Jatropha curcas* demonstrated significant activity against gram-positive bacteria and moderate activity against gram-negative bacteria. The antibacterial and antifungal efficacy ranged from 7 to 22 mm and 10 to 20 mm, respectively. This highlights the plant's potential use in developing natural antimicrobial agents and preservatives.<sup>21</sup>

## Antimicrobial Activity of Evolvulus nummularius

*Evolvulus nummularius* is a perennial herb belonging to the Convolvulaceae family, widely known for its medicinal properties. The plant exhibits antimicrobial and anti-helminthic activities, and its extracts contain bioactive compounds such as alkaloids, saponins, flavonoids, tannins, and phenolic compounds.<sup>22</sup>

The aerial parts of *Evolvulus nummularius* have been analyzed through UV-visible spectroscopy and FTIR, revealing the presence of chlorophyll and several essential trace elements. These elements, including calcium, magnesium, iron, potassium, and zinc, contribute to the plant's therapeutic and antimicrobial properties. Additionally, the presence of flavonoids has been linked to the antimicrobial potential of the plant.<sup>23</sup> Although *Evolvulus nummularius* is primarily recognized for its medicinal applications, including wound healing and fever reduction, its antimicrobial potential remains underexplored. Further research is needed to isolate and identify the active constituents responsible for its antimicrobial activity and evaluate their efficacy against specific pathogens.

### **Neuroprotective Activity**

### Jatropha integerrima:

The methanolic extract of *Jatropha integerrima* flowers exhibited moderate inhibition of acetylcholinesterase (AChE), an enzyme involved in neurodegenerative disorders such as Alzheimer's disease. The extract showed an IC<sub>50</sub> value of 442.82 $\mu$ g/ml for AChE inhibition, with the highest inhibition (53.23%) observed at 1000  $\mu$ g/ml concentration. Additionally, the extract effectively inhibited tyrosinase, an enzyme implicated in neurodegenerative processes, with an IC<sub>50</sub> value of 86.20 $\mu$ g/ml and a maximum inhibition of 61.67%. The presence of bioactive compounds such as saponins, flavonoids, phenols, quinones, and proteins in the floral extract may contribute to its neuroprotective potential. These findings suggest that *Jatropha integerrima* holds promise for further investigation in neurodegenerative disease treatment.<sup>16</sup>

#### Evolvulus nummularius

*Evolvulus nummularius* exhibits potent antioxidant properties that help in scavenging free radicals and reducing lipid peroxidation. This significantly prevents oxidative damage to neuronal cells, which is crucial in combating neurodegenerative disorders like Alzheimer's and Parkinson's diseases. Chronic neuroinflammation plays a key role in the progression of neurodegenerative diseases. The plant's bioactive compounds exhibit neuroprotection by preventing apoptosis of neuronal cells, a critical mechanism in the pathogenesis of neurodegenerative diseases. This is achieved by modulating cellular signaling pathways and maintaining mitochondrial integrity.

The neuroprotective effects also include cholinergic enhancement, which supports cognitive function by inhibiting acetylcholinesterase and increasing acetylcholine levels in the brain. The phytochemicals present in *Evolvulus nummularius* demonstrate multitargeted neuroprotective effects through antioxidative, anti-inflammatory, and mitochondrial function enhancement.<sup>24</sup>

## **COMPARATIVE ANALYSIS**

#### Efficacy

• *Evolvulus nummularius* demonstrates stronger neuroprotective effects, particularly in enhancing cognitive function and protecting neural cells from oxidative stress and inflammation.<sup>25</sup> *Jatropha integerrima*, on the other hand, excels in anti-inflammatory and antimicrobial activities, showing significant inhibition of pro-inflammatory mediators such as TNF- $\alpha$  and PGE2.<sup>2</sup>

## Safety

Both plants exhibit low toxicity at therapeutic doses. *Jatropha integerrima* may cause mild gastrointestinal discomfort in some individuals, though no severe adverse effects have been reported.<sup>2</sup> *Evolvulus nummularius* demonstrated some cytotoxicity at high concentrations in in vitro studies, particularly affecting epithelial cells, suggesting caution for long-term or high-dose use.<sup>26</sup>

## **Therapeutic Potential**

• *Evolvulus nummularius* shows promise as a natural neuroprotective agent, potentially beneficial for treating neurodegenerative diseases like Alzheimer's and improving cognitive function.<sup>25</sup> *Jatropha integerrima* could be utilized as a topical and systemic anti-inflammatory agent, beneficial for inflammatory disorders and microbial infections.<sup>2</sup>

Parameter	Evolvulus nummularius	Jatropha integerrima	
Efficacy	Strong neuroprotective effects, enhances cognitive function, protects neural cells from oxidative stress & inflammation.	Excels in anti-inflammatory & antimicrobial activities, significantly inhibits TNF- $\alpha$ & PGE2 .	
Safety	Low toxicity at therapeutic doses; some cytotoxicity at high concentrations in vitro, affecting epithelial cells.	Low toxicity at therapeutic doses; may cause mild gastrointestinal discomfort in some individuals.	
Therapeutic Potential	Promising neuroprotective agent, may help treat neurodegenerative diseases like Alzheimer's, improves cognitive function.	Useful as a topical & systemic anti-inflammatory agent, beneficial for inflammatory disorders & microbial infections.	

Table 3: Comparative Analysis of *Evolvulus nummularius* and *Jatropha integerrima* 

# CONCLUSION

Both *Jatropha integerrima* and *Evolvulus nummularius* exhibit promising pharmacological activities with distinct therapeutic applications. *Jatropha integerrima* is particularly effective in managing inflammatory and microbial infections, while *Evolvulus nummularius* excels in neuroprotection and cognitive enhancement. Despite their therapeutic benefits, long-term safety studies and clinical trials are required to determine their optimal use and potential side effects. Future research should focus on isolating active compounds and exploring their mechanisms of action to develop standardized herbal formulations.

# **CONFLICT OF INTEREST**

The authors declare that there are no conflicts of interest regarding the publication of this review paper. The research was conducted independently, and no financial, commercial, or institutional relationships influenced the content or conclusions of this work.

# DATA AVAILABILITY STATEMENT

No new data were generated or analyzed in this study. All information presented in this review is derived from previously published literature, which has been appropriately cited in the manuscript. Therefore, data availability is not applicable.

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