

Anti-inflammatory potential of medicinal plants from the Euphorbiaceae family

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Abstract: Inflammation is a vital physiological response that protects the body against infection and tissue injury, but persistent inflammation contributes to the development of several chronic diseases, including arthritis, cardiovascular disorders, diabetes, neurodegenerative diseases and cancer. Although conventional anti-inflammatory drugs are effective, their prolonged use is often associated with adverse effects, which calls for the need for safer therapeutic alternatives. Euphorbiaceae is one of the largest families of flowering plants, rich in structurally diverse secondary metabolites with significant pharmacological potential. Numerous species have been traditionally used to treat inflammatory disorders and have been scientifically validated for their anti-inflammatory activities. Bioactive compounds such as flavonoids, phenolics, tannins, terpenoids, triterpenoids, alkaloids and certain fatty acids have been shown to suppress inflammatory mediators, modulate cytokine production and inhibit key signalling pathways involved in inflammation. Present review is based on a systematic collection and compilation of research data available on scientific databases, reviewed and presented in this paper. It summarizes the anti-inflammatory bioactives reported from selected Euphorbiaceae species, focusing on their common name, habit, phytochemistry and pharmacological activities. It also discusses the prospects of plants of this family as promising sources of natural anti-inflammatory agents.

Keywords: Anti-inflammation, bioactive compounds, Euphorbiaceae, natural products, traditional medicine

Introduction

The family Euphorbiaceae is one of the largest and most diverse families of flowering plants, comprising approximately 300 genera and over 7,500 species distributed across tropical, subtropical and temperate regions of the world (Kemboi et al., 2020). The species of this family have a remarkable morphological diversity, ranging from annual herbs and shrubs to large trees and succulents (Simpson, 2010). Several species are characterized by the presence of milky latex, specialized secretory tissues and an abundance of structurally diverse secondary metabolites that play an important role in plant defense against herbivores, pathogens and environmental stress (Simpson, 2010). The members of this family contribute to ecosystem functioning by stabilizing soil, supporting pollinators and providing food and shelter for numerous organisms (Shaaban et al., 2018). Many species are also cultivated as ornamentals, oilseed crops, timber resources and medicinal plants. They have also occupied an important place in traditional healthcare systems like Ayurveda, Siddha, Traditional Chinese Medicine and folk medicinal practices. Different plant parts such as leaves, bark, roots, seeds, fruits and latex have been used to treat a wide range of ailments, including wounds, skin infections, fever, gastrointestinal disorders, respiratory diseases and rheumatism (Amtaghri et al., 2022). Inflammation is one of the major underlying reasons and contributing factors to all these disorders. In simple terms, Inflammation is a complex biological response initiated by the immune system to protect the body against infection, tissue injury and harmful stimuli (Chavda et al., 2024). Although acute inflammation is essential for tissue repair and host defense, persistent or uncontrolled inflammation contributes to the development of several chronic disorders, including arthritis, cardiovascular diseases, diabetes mellitus, inflammatory bowel disease, neurodegenerative disorders and certain types of cancer (Chen et al., 2017). Conventional anti-inflammatory drugs, particularly non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids, are effective in controlling inflammation but are often associated with adverse effects such as gastrointestinal ulceration, renal impairment, hepatotoxicity and increased cardiovascular risk following prolonged use (Sohail et al., 2023). These limitations have stimulated the search for safer and more effective anti-inflammatory agents from natural sources. Plants in this scenario represent an important reservoir of bioactive secondary metabolites capable of modulating inflammatory pathways through multiple mechanisms (Mendoza-Calderón et al., 2026). Phytochemicals such as flavonoids, phenolic acids, tannins, terpenoids, alkaloids, steroids and triterpenoids exhibit anti-inflammatory activity by scavenging reactive oxygen species (ROS), suppressing pro-inflammatory cytokines, inhibiting cyclooxygenase (COX) and lipoxygenase (LOX) enzymes, regulating nitric oxide production and modulating signalling pathways including nuclear factor-kappa B (NF- κ B) and mitogen-activated protein kinases (Gonfa et al., 2023). Due to their multi-target mode of action, these compounds have attracted considerable attention as potential alternatives to conventional anti-inflammatory therapies. Numerous members of the Euphorbiaceae (Plate 1) have been reported to contain bioactive molecules such as quercetin, kaempferol, rutin, rottlerin, bergenin, gallic acid, ellagic acid, ricinoleic acid, jatrophone and several diterpenoids, triterpenoids, sterols and phenolic compounds that have significant anti-inflammatory effects in both *in vitro* and *in vivo* studies (Félix-Silva et al., 2014). These compounds exert their activity by reducing oxidative stress, inhibiting inflammatory mediators

including tumournecrosis factor- α (TNF- α), interleukins (IL-1 β and IL-6), cyclooxygenase-2 (COX-2), inducible nitric oxide synthase (iNOS) and nitric oxide (NO) production, thereby limiting tissue damage and promoting the resolution of inflammation (García-Mediavilla et al., 2007). Although numerous pharmacological studies have reported the anti-inflammatory properties of individual Euphorbiaceae species, the available information remains dispersed across different plant species, phytochemical classes and experimental models. The present review compiles the information from accessible flora references and research data available from online scientific databases and clearly discusses the major anti-inflammatory bioactives reported from the selected members of the Euphorbiaceae family found in India, mentioning their common names, habit, bioactive compounds viable against inflammation, pharmacological evidence and potential applications in the development of safer plant-based anti-inflammatory therapeutics.

Methodology

The information presented in this review was gathered through an extensive search of published literature on the Euphorbiaceae family, with a primary focus on anti-inflammatory bioactive compounds and their pharmacological significance. Relevant publications were identified from electronic databases, including Google Scholar, Scopus, PubMed, Web of Science and Plants of the World Online (POWO). These sources were used to obtain updated taxonomic information, original research articles, review papers, ethnobotanical records and pharmacological reports. The literature search was carried out using combinations of the keywords 'Euphorbiaceae', 'milky sap weed', 'inflammation', 'anti-inflammatory agents', 'oxidative stress' and 'ethnomedicine'. To broaden the scope of the review, information from regional floras, books and published reports describing species distribution and traditional medicinal applications was also examined. Only studies supported by reliable scientific evidence and authenticated ethnomedicinal information were considered. The collected data were carefully screened, compared and organized into appropriate thematic sections to provide a concise and systematic overview of the anti-inflammatory bioactive compounds reported from different species of the Euphorbiaceae family found in India (Kumar, 2025; Sahu et al., 2026).

Anti-inflammatory bioactive compounds from medicinal Euphorbiaceae species

The medicinal plants of the Euphorbiaceae family are a storehouse of pharmacologically important secondary metabolites (Islam et al., 2019), particularly flavonoids, phenolic compounds, tannins, triterpenoids and diterpenoids. Flavonoids are the most commonly reported class of bioactive compounds, occurring in almost all the listed species (Table 1). They are known to suppress inflammatory mediators by inhibiting pro-inflammatory cytokines, cyclooxygenase (COX) enzymes, nitric oxide production and oxidative stress (Ferraz et al., 2020). Well-studied species like *Croton bonplandianus* inhibit TNF- α , IL-6, COX enzymes and nitric oxide (NO) production (Yasin et al., 2021) and *Homonoia riparia* (Plate 1e) targets the COX-2 pathway. Plant species of a well-known genus of this family, *Chrozophora*, have shown potential in reducing carrageenan-induced paw edema, indicating their ability to suppress acute inflammatory responses (Khan et al., 2024). The anti-inflammatory activity of these plants is most likely due to the synergistic action of various

phytochemicals present in them rather than a single bioactive compound. Many of these plants also possess significant antioxidant, cardioprotective, antihyperlipidemic and cytoprotective activities (Silva et al., 2025). Unique metabolites found in this family, such as rottlerin in *Mallotus philippensis*, ricinoleic acid in *Ricinus communis* and jatrophone in *Jatropha gossypifolia*, point towards the chemical diversity of Euphorbiaceae (Table 1).

Table 1: Anti-inflammatory bioactives from plants of the Euphorbiaceae family

Plant species	Common name	Habit	Major anti-inflammatory bioactives	Reported pharmacological properties	Source(s)
<i>Acalypha indica</i> L. (Plate 1a)	Indian copperleaf (E)	Herb	Flavonoids, quercetin, kaempferol, phenolics	Cytokine suppression, antioxidant, cardioprotective, antihyperlipidemic	Sharma et al., (2025)
<i>Baliospermum solanifolium</i> (Bur m.) Suresh	Red physic nut (E)	Subshrub or shrub	Sterols, triterpenoids, flavonoids, kaempferol glycosides	Antioxidant, lipid-lowering potential, protection of cells against peroxidative cellular toxicity and reduction of inflammatory cell infiltration	Pipatrattanaseree et al., (2019); Kuttappan et al., (2025)
<i>Bridelia retusa</i> (L.) A.Juss.	Spinous kino tree (E)	Shrub or tree	Gallic acid, ellagic acid, tannins, triterpenoids, flavonoids	Cardioprotective, antioxidant, reduction of tissue swellings and analgesic	Kumar and Jain, (2014); Tatiya et al., (2017)
<i>Bridelia stipularis</i> (L.) Blume	Climbing bridelia (E)	Scrambling shrub or tree	Tannins, flavonoids and triterpenoids	Antioxidant, anti-inflammatory	Acharyya et al., (2022)
<i>Chrozophora rotleri</i> (Geiseler) Spreng. (Plate 1d)	Indian chalk plant (E)	Sub shrub	Flavonoids, tannins, alkaloids	Anti-inflammatory (suppression of carrageenan-induced hind paw edema),	Talluri et al., (2016)

				antioxidant, antihyperlipidemic	
<i>Croton bonplandianus</i> B aill. (Plate 1b)	Ban tulusi (H)	Shrub	Diterpenoids, flavonoids, phenolics	Antioxidant, anti-inflammatory [inhibition of pro-inflammatory cytokines such as (TNF- α and IL-6), cyclooxygenase (COX) enzymes and nitric oxide]	Yasin et al., (2021)
<i>Euphorbia hirta</i> L. (Plate 1c)	Asthma weed (E)	Herb	Quercetin, rutin, gallic acid, tannins, triterpenoids and sterols	Antihypertensive, antioxidant, vasorelaxant, mast cell stabilization and enzyme inhibition	Dwijayanti et al., (2024); Bai et al., (2025)
<i>Homonoia riparia</i> Lour. (Plate 1e)	Willow-leaved spurge (E)	Shrub or tree	Flavonoids, triterpenoids, polyphenols	Antioxidant, anti-inflammatory (targeting pro-inflammatory pathways such as COX-2)	Pyun et al., (2017)
<i>Jatropha gossypifolia</i> L.	Bellyache bush (E)	Shrub	Flavonoids, terpenoids (jatrophone), tannins and phenolics	Antioxidant, antihyperlipidemic	Félix-Silva et al., (2014); Xavier-Santos et al., (2018)
<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	Shield-leaf tree (E)	Tree	Flavonoids, phenolics, steroids and tannins	Antioxidant, anti-inflammatory potential (reduction of tissue inflammation and inhibition of inflammatory	Sree Lakshmi et al., (2025); Honnappa et al., (2025)

				pathways)	
<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Kamala tree (H)	Shrub or tree	Polyphenol (rosterlin), flavonoids, chalcones	Antioxidant, hypolipidemic, reduction of inflammation by regulating inflammatory cytokines, cytoprotective	Bodas et al., (2022); Sultana et al., (2025)
<i>Mallotus repandus</i> (Rottler) Müll.Arg.	Triangular-leaf mallotus (E)	Scrambling shrub or tree	Phenolics, flavonoids, triterpenes, isocoumarin (Bergenin), tannins and saponins	Antioxidant (Mallorepine), anti-inflammatory (synergistic effects of key phytochemical classes)	Hasan et al., (2014); Kerdphon et al., (2025)
<i>Ricinus communis</i> L.	Castor oil plant (E)	Shrub or tree	Ricinoleic acid (fatty acid), flavonoids, tocopherols, alkaloids and phenolic acids	Inhibition of inflammatory mediators, scavenging free radicals and modulating cell signaling pathways	Abdul et al., (2018); Luzardo-Ocampo et al., (2022)
<i>Suregada multiflora</i> (A.Juss.) Baill.	False lime tree (E)	Shrub or tree	Flavonoids, diterpenoid (helioscopinoli d A, C and suremulol D), triterpenoid, phenolic compounds	Antioxidant, anti-inflammatory and cardioprotective activity	Tewtrakul et al., (2011)

(E: English; H: Hindi)

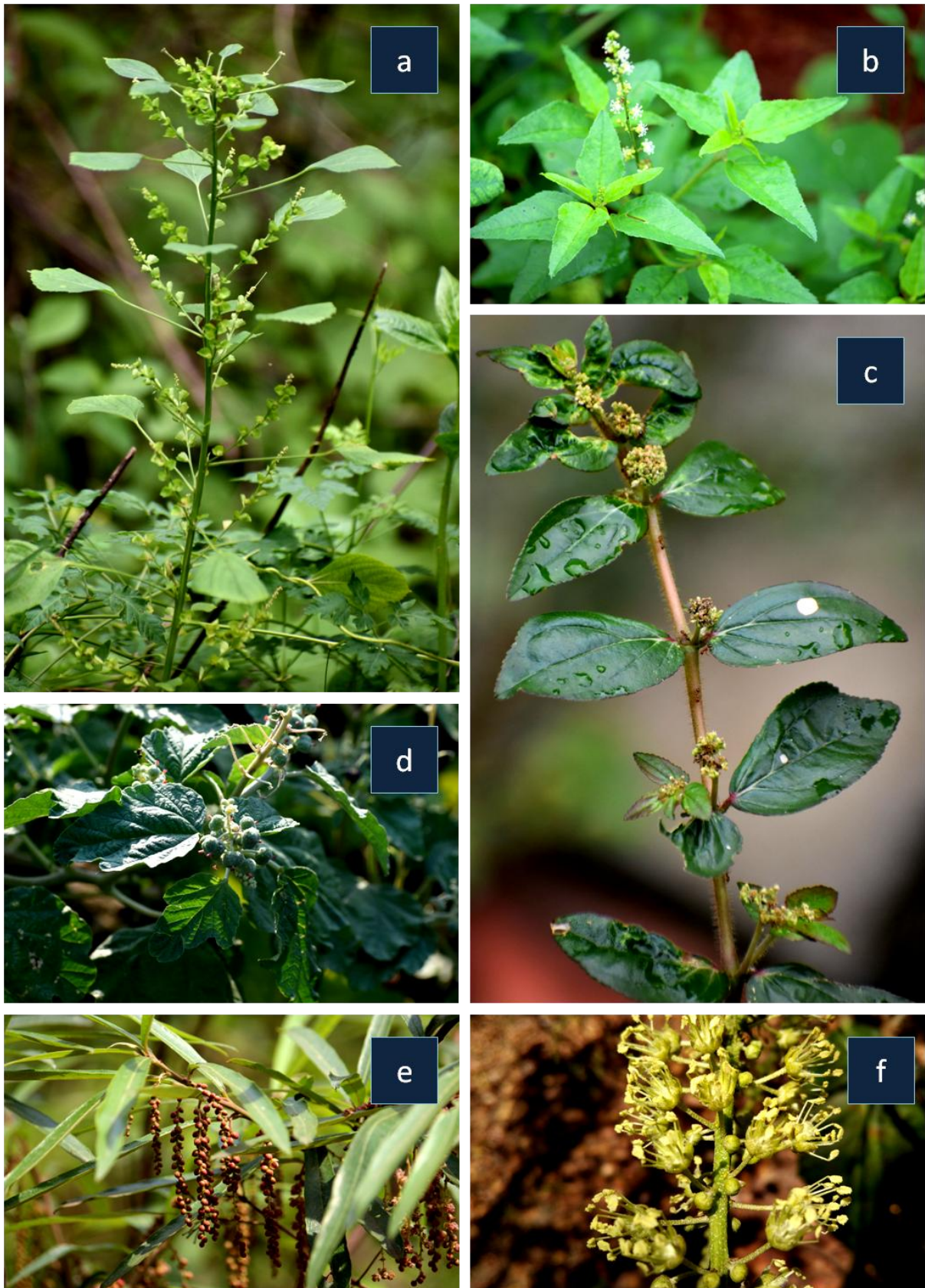


Plate 1: Some plant species of the Euphorbiaceae family (a) aerial plant parts of *Acalypha indica*, (b) flowers of *Croton bonplandianus*, (c) flowers of *Euphorbia hirta*, (d) fruits of *Chrozophora rotleri*, (e) fruits of *Homonoia riparia* and (f) flowers of *Croton persimilis*

Future aspects

The present review compiled the pharmacological aspect of the anti-inflammatory potential of the Euphorbiaceae species. However, the reported efficacy varies depending on factors such as plant part used, extraction solvent, phytochemical composition and experimental model. This variability highlights the need for standardized extraction procedures and bioassay protocols to facilitate comparison among studies. Isolation of active constituents, detailed mechanism-of-action studies, toxicity assessments and clinical validation are still lacking for many species. Addressing these limitations will be essential for translating the anti-inflammatory potential of Euphorbiaceae bioactives into safe and effective therapeutic agents.

Conclusion

Euphorbiaceae family is an important source of bioactive secondary metabolites with significant anti-inflammatory potential. Several species possess phytochemicals such as flavonoids, phenolics, tannins, terpenoids, triterpenoids and alkaloids that have shown the ability to modulate inflammatory mediators and signaling pathways. Traditional medicinal uses of these plants are increasingly supported by experimental evidence, highlighting their value as potential alternatives to synthetic anti-inflammatory drugs. Deeper study regarding their phytochemistry, extraction, as well as conservation, is still needed to translate research into plant-based products. Beyond that, Euphorbiaceae species represent a promising natural resource for the discovery and development of safer and more effective anti-inflammatory agents.

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