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**Review Article**

# Medicinal plants of Zingiberaceae as natural sources of anti-inflammatory agents

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**Abstract:** Inflammation is a vital response involved in host defense and tissue repair; however, chronic inflammation is closely associated with the progression of numerous diseases, including arthritis, diabetes, cardiovascular disorders, neurodegenerative diseases, cancer and respiratory illnesses. Although conventional anti-inflammatory drugs are effective, their long-term use often leads to adverse side effects, thereby increasing the demand for safer and naturally derived therapeutic alternatives. Plants belonging to the family Zingiberaceae have been used since ancient times in traditional medicinal systems such as Ayurveda, Traditional Chinese Medicine and folk medicine for the treatment of inflammation-related disorders. Various species, including *Zingiber officinale*, *Curcuma longa*, *Curcuma zedoaria*, *Hedychium coronarium* and*Amomum subulatum,* are rich sources of bioactive phytochemicals with potent anti-inflammatory properties. Phytochemical investigations have identified numerous active constituents such as 1,8-cineole, β-caryophyllene, curcumenol, germacrone, cardamonin, alpinetin, xanthorrhizol, limonene, α-pinene, terpinen-4-ol andcoronarin diterpenes that modulate inflammatory pathways through inhibition of cytokines, cyclooxygenase enzymes, nitric oxide production and NF-κB signaling. The synergistic interactions among terpenoids, flavonoids, phenolics and phytosterols contribute significantly to the therapeutic efficacy of Zingiberaceous plants. This review highlights the bioactive

compoundshaving anti-inflammatory propertiesof several Zingiberaceae species and emphasizes their importance as promising candidates for the development of safer plant-based anti-inflammatory therapeutics.

**Keywords:** Anti-inflammation, ethnomedicine, modern therapeutics, secondary metabolites, Zingiberaceae

## Introduction

Inflammation is a fundamental biological response that protects the body against infection, tissue injury and harmful stimuli (Chen et al., 2017). Acute inflammation is generally beneficial and essential for healing; however, chronic or uncontrolled inflammation contributes to the pathogenesis of numerous disorders, including arthritis, asthma, cardiovascular diseases, diabetes, neurodegenerative diseases, inflammatory bowel disease and cancer (Chavda et al., 2024). Although synthetic anti-inflammatory drugs such as corticosteroids and non-steroidal anti-inflammatory drugs (NSAIDs) are widely used, their long-term administration is often associated with adverse effects, including gastrointestinal irritation, renal toxicity, immunosuppression and cardiovascular complications (Sohail et al., 2023). Consequently, increasing scientific attention has been directed toward naturally occurring bioactive compounds as safer and more effective alternatives for the management of inflammation. Bioactive compounds are naturally occurring secondary metabolites produced by plants, microorganisms and other living organisms that exert pharmacological or physiological effects in humans (Riaz et al., 2023). Among these, terpenoids, flavonoids, phenolics, alkaloids, diarylheptanoids and phytosterols have shown significant anti-inflammatory activity through multiple molecular mechanisms (Nakadate et al., 2025). These compounds modulate inflammatory pathways (Kim and Lee, 2025) by inhibiting pro-inflammatory cytokines such as tumour necrosis factor-alpha (TNF-α), interleukin-1β (IL-1β) and interleukin-6 (IL-6), suppressing cyclooxygenase-2 (COX-2) and inducible nitric oxide synthase (iNOS) and regulating transcription factors including nuclear factor kappa B (NF-κB) and mitogen-activated protein kinase (MAPK). Due to their antioxidant, immunomodulatory and signaling-regulatory properties, plant-derived bioactive compounds are increasingly recognized as promising therapeutic agents for inflammatory-associated disorders. Since the dawn of civilization, medicinal plants belonging to the family Zingiberaceae (Plate 1) have played a prominent role in traditional systems of medicine for the treatment of inflammatory conditions and related ailments. Historical records from Ayurveda, Traditional Chinese Medicine, Unani and Southeast Asian folk medicine indicate that rhizomes, leaves and roots of various species were extensively used to relieve pain, swelling, fever, digestive disturbances, respiratory disorders and rheumatic diseases (Tushar et al., 2010; Das et al., 2025). Species such as *Zingiber officinale*, *Curcuma longa*, *Curcuma zedoaria*, *Hedychium coronarium* and *Amomum subulatum* have long been incorporated into herbal formulations, dietary preparations and ethnomedicinal practices to manage inflammation-related diseases.Therefore, Zingiberaceae plants represent an important reservoir of bioactive anti-inflammatory compounds with significant ethnopharmacological relevance and pharmaceutical potential. Continued exploration of these medicinal species may facilitate the

development of novel plant-based anti-inflammatory therapeutics with improved efficacy and reduced side effects.

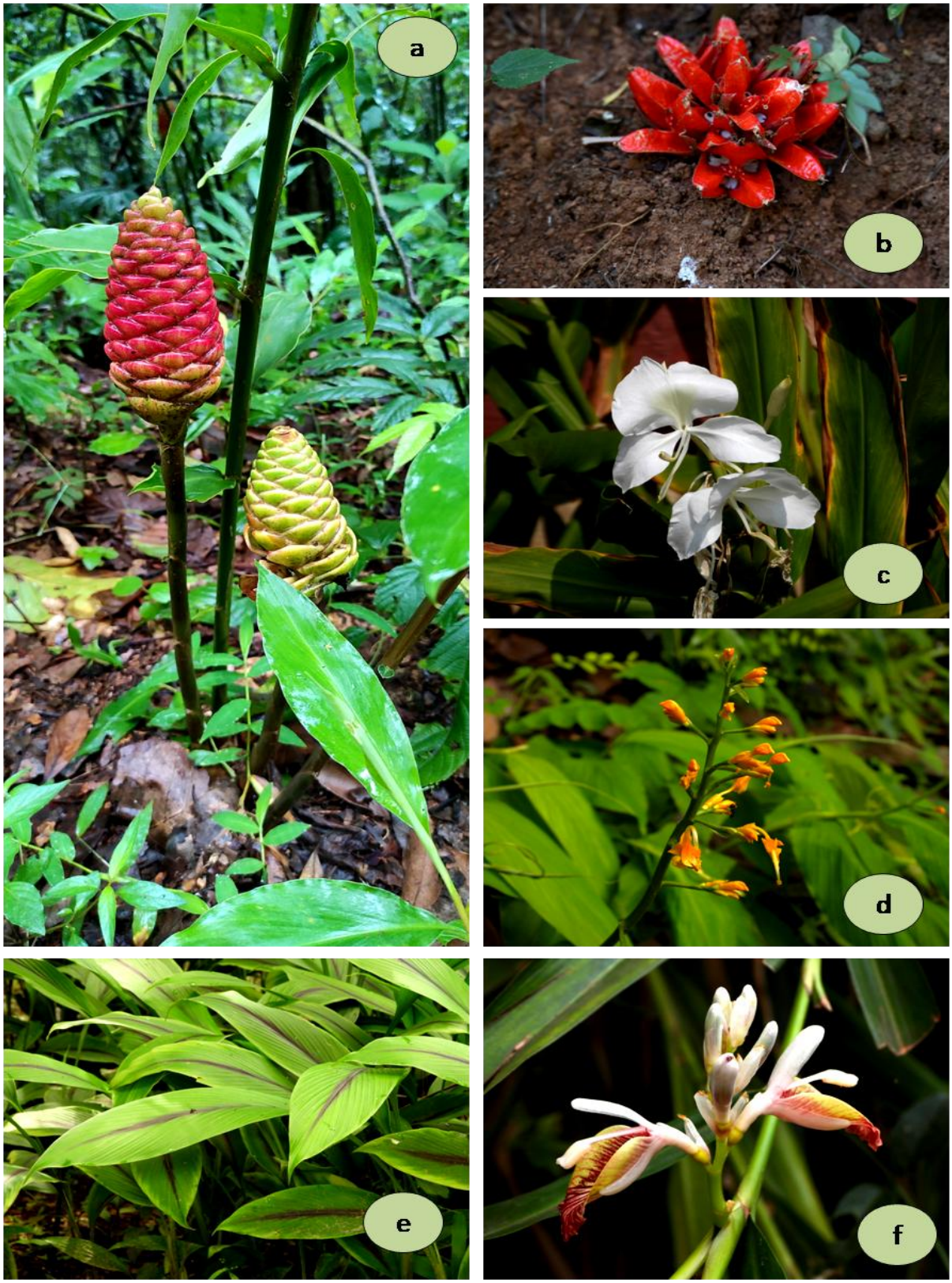


Plate 1: Plant species of family Zingiberaceae; (a) *Zingiber zerumbet*, (b) *Zingiber cernuum*, (c) *Hedychium coronarium*, (d) *Globba racemosa*, (e) *Curcuma caesia* and (f) *Amomum subulatum*

**Methodology**

The present study is based on an extensive survey of published literature related to the family Zingiberaceae. We consulted scientific databases, including Google Scholar, Scopus, PubMed and Web of Science, to retrieve peer-reviewed research articles, review papers, ethnobotanical surveysand pharmacological studies. A variety of keywords such as “Zingiberaceae”, “anti-inflammation”, “bioactives”, “inflammation”, “legumes”, “inflammation inhibitors” and “ethnopharmacology” were used to identify relevant publications. Additionally, regional floras, books and reports that document traditional knowledge and distribution patternswere examined. Only studies containing verifiable scientific or ethnomedicinal data were included in the analysis. The informationgathered was critically analyzed and systematically organized into thematic sections to ensure clarity and coherence (Kumar, 2025; Sahu et al., 2026).

**Anti-inflammatory bioactivity of selected members of Zingiberaceae**

Modern phytochemical and pharmacological investigations have validated many of the traditional claims by identifying numerous anti-inflammatory constituents in Zingiberaceae plants (Plate 1). Essential oil components such as 1,8-cineole, α-pinene, β-pinene, terpinen-4-ol, linalool, limonene, β-caryophyllene and α-humulene are known for their potent anti-inflammatory and antioxidant properties (Table 1). In addition, specialized metabolites including curcumenol, germacrone, dehydrocurdione, cardamonin, alpinetin, xanthorrhizol and various coronarin-type diterpenes have proven records of their ability to suppress inflammatory mediators and signaling pathways in experimental studies (Parveen et al., 2018; Pichetpongtorn et al., 2025; Raut and Bais, 2025). The synergistic interaction of these compounds contributes to the broad therapeutic potential of species of Zingiberaceae against chronic inflammatory diseases.

Table 1: Anti-inflammatory bioactive compounds of selected speciesof Zingiberaceae

| Species | Common name | Ethnomedicinal uses | Anti-inflammatory bioactive compounds | Source(s) |
|---|---|---|---|---|
| *Alpinia galanga* (L.) Willd. | Greater galangal | In the treatment of Diabetes mellitus | 1,8-cineole, β-pinene,1′-acetoxychavicol, Acetate (ACA/ACE), β-sitosterol,Diglucoside (AG-7), Pinostilbene, Pinoresinol | Priyono et al., (2024); Kuzia et al., (2026) |
| *Amomum subulatum* Roxb. (Plate 1f) | Black cardamom | In treating skin inflammation, cough, vomiting, respiratory disorders, etc. | 1,8-cineole, Cardamonin, Alpinetin, Protocatechuic acid, Limonene, α-/β-pinene, Terpineols | Parveen et al., (2018) |

| | | | | |
|---|---|---|---|---|
| *Curcuma aeruginosa* Roxb. | Indian arrowroot | Cough, gastrointestinal disorder, inflammation, etc. | Curcumenol, Germacrone, Furanodiene, Dehydrocurdione, Isocurcumenol, Zederone | Rajkumari and Sanatombi, (2017); Pichetpongtorn et al., (2025) |
| *Curcuma angustifolia* Roxb. | East Indian arrowroot | In the treatment of leprosy, bronchitis, asthma, jaundice, etc. | Germacrone, Curzerene, β-Elemene,Curzerenone | Murthy et al., (2015); Gadnayak et al., (2024) |
| *Curcuma aromatica* Salisb. | Wild turmeric | Used for treating wounds, skin infections, gastrointestinal disorders, insect bites, etc. | Ar-Turmerone, Borneol, Curcumin, Demethoxycurcumin, Linalool, Xanthorrhizol | Rahamanet al., (2020); Umar et al., (2020) |
| *Curcuma caesia* Roxb. (Plate 1e) | Black turmeric | In the treatment of asthma, bronchitis, leucoderma, etc. | 1,8-cineole, α-terpineol, borneol, β-elemene, camphor | Kalita et al., (2019); Paudel et al., (2024) |
| *Curcuma longa* L. | Turmeric | In the treatment of itching, skin ailments and wound healing | Curcuminoids (Curcumin, demethoxycurcumin, bisdemethoxycurcumin), Sesquiterpenes (Ar-turmerone, α-turmerone, β-turmerone, curlone) | Bhowmik et al., (2009); Kuzia et al., (2026) |
| *Elettaria cardamomum* (L.) Maton | Green cardamom | In the treatment of teeth and gum infections, asthma, nausea, digestive disorders, etc. | α-Terpineol, α-Terpinyl acetate, γ-Sitosterol | Ashokkumaret al., (2020); Garza et al., (2021) |
| *Globba racemosa* Sm. (Plate 1d) | Yellow swan flower | In treating stomach pain | Manool, β-caryophyllene, Phytol, β-pinene, Sabinene | Aslam and Ahmad, (2017); Mohanty et al., |

| | | | | |
|---|---|---|---|---|
| | | | | (2025) |
| *Hedychium coronarium* J.Koenig (Plate 1c) | Butterfly ginger | In the treatment of respiratory diseases, gastric problems, rheumatism and blood diseases | Coronarin A-I, Isocoronarin D, Peroxycoronarin D, Ethoxycoronarin D, Pacovatin A, Chrysin, β-Sitosterol | Arya et al., (2022); Raut and Bais, (2025) |
| *Kaempferia galanga* L. | Sand ginger | Cold, dry cough, toothache, rheumatism and hypertension | *trans*-ethyl p-methoxycinnamate, Kaempferol, | Wang et al., (2021) |
| *Zingiber cernuum* Dalzell (Plate 1b) | Curved stem ginger | In treating throat-related issues | trans-Caryophyllene, α-Humulene, Terpinen-4-ol, Caryophyllene oxide | Jagtap, (2015); Thambi and Shafi, (2016) |
| *Zingiber officinale* Roscoe | Ginger | In the treatment of cold, cough, respiratory related disorders | Phosphatidylinositol-3-kinase (PI3K), protein kinase B (Akt), nuclear factor kappa light chain-enhancer of activated B cells (NF-B) | Sahrajabian et al., (2019); Shareef, (2023) |
| *Zingiber purpureum* Roscoe | Cassumunar ginger | Helpful as a mosquito repellent and in relieving muscle pain | Xanthorrhizol,Terpinen-4-ol, B-Pinene, A-Pinene, Myrcene, B-Sesquiphellandrene | Nishidono et al., (2024) |
| *Zingiber zerumbet* (L.) Roscoe ex Sm. (Plate 1a) | Shampoo ginger | In the treatment of stomach ache, toothache, cough, sprain, fever, etc. | Zerumbone, 3-O-methyl kaempferol, kaempferol-3-O-(2,4-di-O-acetylα-L-rhamnopyranoside), kaempferol-3-O-(3,4-di-O-acetylα-L-rhamnopyranoside) | Chienet al., (2008); Yob et al., (2011) |

**Future aspects**

The application of biotechnology, tissue culture, metabolic engineering and synthetic biology may further enhance the production of valuable anti-inflammatory metabolites from Zingiberaceae species. But sustainable cultivation and conservation strategies are more essential to preserve medicinal plant biodiversity and ensure the continuous availability of phytochemical resources. Future studies integrating ethnopharmacology, phytochemistry, molecular pharmacology and clinical medicine may facilitate the development of novel multi-target anti-inflammatory drugs derived from Zingiberaceae plants with reduced side effects and improved therapeutic efficacy.

**Conclusion**

Plants of the family Zingiberaceae have been used for centuries to treat inflammatory disorders. Modern phytochemical and pharmacological studies have confirmed that these plants contain numerous bioactive compounds, including terpenoids, flavonoids, phenolics and phytosterols, with significant anti-inflammatory activity. Compounds such as 1,8-cineole, β-caryophyllene, curcumenol, germacrone, cardamonin and terpinen-4-ol act through multiple mechanisms, including inhibition of inflammatory cytokines and signaling pathways. Due to their therapeutic potential and relatively fewer side effects, Zingiberaceae plants represent promising natural sources for developing safer anti-inflammatory agents and for future pharmaceutical applications.

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