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(REVIEW ARTICLE)

# Ethno-medicinal, ethnopharmacological, and aroma chemical aspects of *Eucalyptus* species

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## Abstract

Eucalyptus species, particularly Eucalyptus globulus Labill., represent one of the most widely studied genera in the family Myrtaceous due to their remarkable ethnomedicinal, ethnopharmacological, and industrial significance. This review comprehensively explores the morphology, phytochemistry, traditional medicinal uses, pharmacological properties, and aroma chemical aspects of E. globulus. Various parts of the plant—leaves, bark, fruits, and gums—contain diverse bioactive compounds such as flavonoids, terpenoids, phenolics, alkaloids, and essential oils, with 1,8-cineole (eucalyptol) as the principal component responsible for its distinctive fragrance and biological activity. Traditional applications across global medicinal systems highlight its role in treating respiratory, inflammatory, and infectious disorders. Modern studies further support its antimicrobial, antioxidant, anti-inflammatory, and insecticidal properties. Advanced extraction methods, including steam distillation, microwave-assisted hydro distillation, and solar-based techniques, have improved essential oil yield and quality. Furthermore, nano emulsion formulations and biorefinery approaches offer sustainable and eco-friendly prospects for pharmaceutical, cosmetic, and aromatic industries. This review consolidates existing knowledge while emphasizing recent advances and future directions for the valorization of Eucalyptus globulus as a multifunctional bioresource.

**Keywords:** Eucalyptus Globulus; 1,8-Cineole; Essential Oil; Phytochemistry; Ethnomedicine; Pharmacology; Aroma Compounds; Nano Emulsion; Sustainability

## 1. Introduction

The genus Eucalyptus—a dominant representative of the family Myrtaceous—comprises over 700 species, primarily native to Australia, with a few naturally distributed in nearby regions such as New Guinea and the Philippines.[1][4] Among them, Eucalyptus globulus Labill., commonly known as blue gum, has gained global recognition for its exceptional therapeutic, aromatic, and industrial value. The term Eucalyptus originates from the Greek words eu (well) and calypso (to cover), referring to the operculum that encloses the flower bud until it blooms—a distinctive botanical trait of this genus.[1][4]

Traditionally, Eucalyptus globulus has been widely utilized in diverse ethnomedical systems including Aboriginal, Ayurvedic, Chinese, African, and European medicine. Various parts of the plant—such as its leaves, bark, fruit, and essential oil—have been used to manage respiratory ailments, fever, pain, wounds, and microbial infections.[3] The essential oil derived from the leaves, rich in 1,8-cineole (eucalyptol), is highly valued for its antiseptic, anti-inflammatory, and expectorant properties. In addition to its medicinal significance, E. globulus also plays an important role in the pharmaceutical, cosmetic, and fragrance industries due to its characteristic camphoraceous aroma and diverse biological activities.[18][19][20]

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Phytochemical analyses reveal that E. globulus contains a wide range of secondary metabolites, including flavonoids, terpenoids, phenolics, tannins, alkaloids, and fatty acids, which contribute to its pharmacological efficacy.[8][9][10] Among its bioactive compounds, 1,8-cineole remains the principal component, forming 60–80% of the essential oil, and is primarily responsible for its antimicrobial and aromatic characteristics.[16][26] Modern extraction and analytical techniques—such as steam distillation, microwave-assisted hydro distillation, GC–MS profiling, and HPLC quantification—have enabled better understanding of the plant's chemical composition and activity spectrum.[11][26] Recent advancements have focused on improving the sustainability and efficacy of Eucalyptus essential oil production through green extraction methods, nano emulsion formulations, and integrated biorefinery models.[25][27][28] Such developments not only enhance yield and product stability but also align with global trends toward eco-friendly and renewable natural products. This review aims to provide a comprehensive overview of the ethnomedicinal, phytochemical, ethnopharmacological, and aromatic characteristics of Eucalyptus globulus, prospects in sustainable pharmaceutical and fragrance applications.

*Taxonomy: [3][29]*

**Figure 1** Leaves of Eucalyptus globulus. Source: © Blick Winkel / Alamy Stock Photo (licensed image)
Available at: www.paramountplants.co.uk (Accessed November 2025).

- Kingdom - Plantae
- Clade - Angiosperms
- Clade – Eudicots
- Order - Myrtales
- Family - Myrtaceous
- Genus - Eucalyptus Lahr.
- Species - Eucalyptus globulus Labill.
- Synonyms - Eucalyptus gigantea Dehn., Eucalyptus glauca Acon. ex-DC., Eucalyptus globalists St.-Lag., Eucalyptus globulus subsp. globulus, Eucalyptus maiden subsp. globulus (Labill.) J.B. Kirkp., and Eucalyptus perfoliate Deaf.

## 2. Morphology

### 2.1. Classification and Morphological [1][3][4]

The genus Eucalyptus, a defining component of Australian vegetation, belongs to the extensive family Myrtaceous, which also includes Syzygies and Melaleuca.[1][4] The term Eucalyptus originates from the Greek words EU and calypso, meaning "well covered," referring to the unique operculum—a cap formed by the fused calyx and corolla that encloses the flower bud until it blooms.[1][4] This genus was first described scientifically by Heritier in 1788 as Eucalyptus oblique and stands as a remarkable evolutionary outcome of Gondwanan flora adapting to the increasingly arid Australian environment.[1] Over time, its classification has been refined, particularly through the research of Pryor and Johnson (1971) and Hill and Johnson (1995), who identified subgenera such as Lymphocytes and later established Crombie as a separate genus for species like C. citriodora.[4]

Morphologically, Eucalyptus shows remarkable diversity, ranging from small shrubs to massive trees reaching up to 90 meters in height.[4][3] Distinctive characteristics are found in the bark structure—classified as deciduous (shedding in ribbons, as in E. globulus) or persistent (remaining intact, as in Stringybark and Ironbark types) [1][4]

**Table 1:** Classification

| **Botanical Feature** | **Details** | **Key Species Example** |
|---|---|---|
| Classification | The species Eucalyptus oblique was first scientifically documented by Heritier in 1788. Subsequent taxonomic revisions by Pryor and Johnson (1971) and later by Hill and Johnson (1995) led to the recognition of various subgenera, including *Lymphocytes*. In 1995, Hill and Johnson also introduced *Crombie* as an independent genus within the *Myrtaceous* family. | Species such as E. citriodora (syn.) were reclassified and placed under the newly established genus Crombie. |
| Habit/Size | The genus exhibits remarkable diversity in form, ranging from small shrubs to towering trees that may grow as high as 90 meters. | - |
| Bark | The bark of Eucalyptus species can be broadly classified as deciduous or persistent. In some species, the bark is deciduous, shedding periodically—either in long ribbons as seen in E. globulus or in large flakes as in E. camaldulensis. Other species possess persistent bark, which remains on the trunk and may be furrowed, as in Ironbark, or fibrous, as in Stringybark and Box types. | - |
| Leaves (Juvenile) | Juvenile leaves differ markedly from the mature ones; they are usually opposite in arrangement, broader in form, and may have a waxy bluish-green (glaucous) surface or a soft, hairy texture. Seedlings typically begin with leaves arranged oppositely. | In certain species, the juvenile leaves may be heart-shaped (cordate), clasping the stem (amplexicaul), or occasionally fused around the stem (concrescent or perfoliate). |
| Leaves (Mature) | Mature leaves are typically alternate in arrangement, leathery in texture (coriaceous), and have entire margins with abundant sclerenchymatous tissue. They are generally lanceolate in form, though in many species they may appear curved or sickle-shaped (falciform). | Leaf venation can be classified as pinnate, where the veins form an angle of 60° or more with the midrib, or oblique, where the veins make an angle of less than 60° with the midrib. |
| Inflorescence | Flowers are typically arranged in inflorescences, which can be umbellate (with a defined structure) or paniculate (with an indeterminate branching pattern). | Flowers are generally clustered, with solitary flowers being uncommon, as seen in E. globulus. |
| Flower | In Eucalyptus, the calyx and corolla are united to form a protective cap called the operculum, which is shed when the flower opens. The flowers are bisexual, radially symmetrical (actinomorphic), and hypogynous in structure. | The operculum is characterized based on its shape and surface texture, such as conical, warty (verrucose), or hemispherical. |
| Fruit | The fruit is a woody capsule (gum-nut) that can take various forms, such as obconical, cylindrical, or hemispherical, and opens through valves to release seeds. | The valves of the capsule may be exserted (protruding beyond the rim), level (aligned with the rim), or enclosed (situated below the rim). |

### 2.2. Common Species Characteristics [1][2][3][4]

**Table 2:** Common Species Characteristics

| Species Name | Bark Type | Flower Grouping | Fruit Shapes and Valve Position |
|---|---|---|---|
| *Eucalyptus globulus* | Deciduous (sheds periodically in long stripes). | Flowers solitary in the leaf axels (sometimes in three in forms/hybrids). Calyx and inner operculum are rough and wanted. | Broadly obconic, capsule slightly protruding. |
| *Eucalyptus viminal is* | Usually smooth and deciduous, but sometimes scaly and persistent. | Usually in threes in the axils. Operculum smooth, dome-shaped to pointed. | Hemisphere; valves protruding. |
| *Eucalyptus oblique* | Normally persistent, thick and fibrous to the upper branches. | Many flowers in axillary umbels. Operculum. Very short, convex. | Pear-shaped; capsule sunk. |
| *Eucalyptus Siberian* | Persistent, thick, and furrowed to be branches. | Many flowers in axillary umbels. Operculum. Very short, hemispheric. | Pear-shaped; capsule sunk. |
| *Eucalyptus camaldulensis* | Deciduous bark peeling in rather broad plates. | - | - |
| *Crombie citriodora (Sine. citriodora)* | Deciduous bark peeling in very small flakes or scales. | - | - |
| *Eucalyptus teratorns* | - | - | Seeds are black. |

### 2.3. Geographical Distribution and Cultivation [1][4][5]

**Table 3:** Geographical Distribution and Cultivation

| Aspect | Detail |
|---|---|
| Origin and Natural Range | The genus is considered to have originated from the ancient landmass of Gondwana (1). Its natural distribution predominantly encompasses Australia and the islands situated east of Wallace's Line (1, 4). The natural latitudinal range of occurrence extends approximately from 7° N to 43° 39′ S (1, 4). |
| Species Diversity | Approximately 550 to 800 species of Eucalyptus have been identified, with the majority being native to Australia (1). |
| Non-Australian Species | Among all species, Eucalyptus delta is the only one that occurs naturally beyond the Australian region, being distributed in areas such as New Guinea and the Philippines (1, 4). |
| Cultivation | The genus Eucalyptus is extensively cultivated across various regions of the world (3). Among its species, Eucalyptus globulus is notably grown in several countries, including Argentina, Chile, China, India, Portugal, and Spain (3). |
| Traditional Use | Eucalyptus globulus has been traditionally utilized for its antiseptic properties and in the treatment of upper respiratory tract ailments such as the common cold, influenza, and sinus congestion (5). |

### 2.4. Ethnomedicinal uses

*2.4.1. Overview*

Eucalyptus globulus Labill. has been recognized for its medicinal importance in many traditional healing systems around the world, including Aboriginal, Ayurvedic (Indian), Chinese, African, European, and American practices.

Various parts of the plant—such as its leaves, bark, fruits, twigs, and essential oil—have been employed to treat conditions related to the respiratory system, fever, joint pain, and infections.

The essential oil, in particular, is valued for its broad therapeutic actions, including antimicrobial, pain-relieving, expectorant, and anti-inflammatory effects, which have made it a key ingredient in several traditional and folk medicines.[3]

### 2.5. Ethnomedicinal Applications of Eucalyptus globulus by Region / System [1][3][6][7]

**Table 4:** Ethnomedicinal Applications of Eucalyptus globulus by Region

| Region / Traditional System | Part Used | Formulation / Local Name | Traditional Use |
|---|---|---|---|
| Aboriginal (Australia) | Leaves | Heated leaves with native honey ("mindi-warrum-bing") | Used internally for severe colds and dysentery |
| China | Fruits ("Anshu Guo") | Decoction | Remedy for cough and fever |
| India (Ayurvedic and Folk) | Leaves and oil ("Karpoor Maram") | Oil and decoction | Used for rheumatism, asthma, migraine, headache; as antispasmodic, decongestant, diaphoretic, and expectorant |
| Maharashtra (Purandhar healers) | Seed oil | Topical | Treats skin diseases |
| Pakistan | Leaves and other parts ("Rufaida") | Decoction | Asthma, cold, cough, throat disorders |
| Philippines | Leaves | Decoction | Treats asthma |
| Bangladesh | Leaf ash + coconut oil | Paste | Treats allergy |
| Iran (Shiraz) | Leaves ("Oralists") | Decoction | Used for diabetes mellitus |
| Pakistan | Leaves and other parts ("Rufaida") | Decoction | Asthma, cold, cough, throat disorders |
| Philippines | Leaves | Decoction | Treats asthma |
| Bangladesh | Leaf ash + coconut oil | Paste | Treats allergy |
| Iran (Shiraz) | Leaves ("Oralists") | Decoction | Used for diabetes mellitus |
| Italy (Europe) | Leaves ("Eucolite") | Decoction | Anti-malarial |
| Portugal (Europe) | Leaves and stem ("Eucalyptol") | Infusion | Analgesic, antiseptic, antirheumatic, aromatic |
| Greece (Europe) | Leaves ("Eukaryotes") | Infusion | Diabetes, influenza, asthma, arthritis; antiseptic, antipyretic |
| Spain (Europe) | Leaves ("Upalite") | Inhalation | Ant catarrhal |
| Algeria (Africa) | Leaves | – | Respiratory diseases |
| Nigeria (Africa) | Leaves ("Bitartrate") | Decoction / topical | Antibacterial, mouthwash, wounds, malaria, jaundice, nasal congestion |
| Morocco and Eritrea (Africa) | Leaves ("Kalakos") | Infusion | Respiratory diseases, diabetes |

| | | | |
|---|---|---|---|
| Colombia (America) | Leaves ("Okal") | Decoction | Expectorant, diabetes, malaria, rheumatism, asthma, flu, sinusitis |
| Brazil (America) | Leaves ("Eucalyptol") | Infusion / vapor | Influenza, nasal congestion, respiratory problems, fever |
| Bolivia (America) | Branch apex | Infusion ("Eukaryotes") | Remedy for cough |
| Peru (America) | Leaves | Decoction | Rheumatism, bronchitis, cold, cough, asthma, bone pain, burn fat |
| Guatemala (America) | Leaves ("Eucalyptol") | Decoction | Remedy for fever |
| Mexico (America) | Leaves | Infusion | Remedy for cough |
| India (Industrial/Medicinal Context) | Leaves, twigs, bark | Oil extraction and gum kino | Used in pharmaceuticals, disinfectants, perfumes, soaps, and honey production |
| General Folk Medicine | Essential oil | Inhalation, topical, mouthwash | Used for cough, cold, muscular pain, wounds, dental infections, burns, and as antiseptic |

### 2.6. Summary of Ethnomedicinal Importance:[1][3][6][7]

Across various traditional healing systems, Eucalyptus globulus holds significant ethnomedicinal value and is used for a wide range of health conditions:

- Respiratory Disorders: Commonly employed to relieve cough, cold, bronchitis, asthma, influenza, and sinus congestion.
- Pain and Inflammation: Applied in the management of rheumatism, muscle and joint pain, and headaches due to its soothing properties.
- Infectious and Febrile Conditions: Traditionally used to reduce fever and treat ailments like malaria, wounds, dysentery, and skin infections.
- Metabolic Issues: Utilized in folk medicine to help manage diabetes.
- Other Applications: Also valued as a natural antiseptic, deodorant, and mosquito repellent, and in Thailand, it is even used as a source of textile dye known locally as "Yu Ka."

## 3. Phytochemical Constituent

### 3.1. Volatile/Aromatic Constituents (Crude Extracts/Screening and HPLC Qualification) [8][9][10]

**Table 5:** Volatile/Aromatic Constituents

| Compound Name | Phytochemical Class | Source/Part Used | Qualitative/Quantitative Data |
|---|---|---|---|
| Flavonoids (General) | Flavonoids | Leaves (Methanol/Ethanol) | Most Prominent class of Bioactive compounds (54.37% total quantified). Quantitative yield of 59%. |
| Alkaloids (General) | Alkaloids | Leaves (Methanol) | Most abundant preliminary phytochemical: 11.1 mg/100g. Quantitative yield of 64%. |
| Saponins (General) | Saponins | Leaves (Various extracts) | Positive in qualitative screening. Quantitative yield of 55%. |
| Phenols (General) | Phenolics | Leaves (Various extracts) | Positive in qualitative screening. Quantitative yield of 63%. |

| | | | |
|---|---|---|---|
| Tannins (General) | Tannins | Leaves (Various extracts) | Positive in qualitative screening. |
| Anthraquinones (General) | Anthraquinones | Leaves (Methanol) | Detected: 11.02 mg/100g. |
| Flavanone | Flavonoid | Leaves (Methanol extract – HPLC) | Concentration: 28.32ug/ml (20.65% composition) |
| Rib alinidine | Alkaloid/Other | Leaves (Methanol extract – HPLC) | Concentration: 25.21ug/ml (18.39% composition) |
| Linamarin | Unknown/Other | Leaves (Methanol extract – HPLC) | Concentration: 21.57ug/ml (15.74% composition) |
| Catechin | Flavonoid (Flavan-3-ol) | Leaves (Methanol extract – HPLC) | Concentration: 18.4285ug/ml (13.43% composition) |
| Gallo catechin | Flavonoid (Flavan-3-ol) | Leaves (Methanol extract – HPLC) | Concentration: 17.65ug/ml (12.87% composition) |
| Kaempferol | Flavonoid (Flavanol) | Leaves (Methanol extract – HPLC) | Concentration: 14.15ug/ml (10.32% composition) |
| Resveratrol | Phenolic (Stilbene) | Leaves (Methanol extract – HPLC) | Concentration: 6.7431ug/ml (4.92% composition) |
| Hexadecenoic acid | Fatty Acid | Gum (Stem Bark) - GC-MC | Bioactive compound identified in the gum extract. |
| Octadecenoic acid methyl ester | Fatty Acid Ester | Gum (Stem Bark) - GC-MC | Bioactive compound identified in the gum extract. |
| Hexaoxane | Alkane | Gum (Dichloromethane Fraction) – GC-MS | 1.36% area in GC – MC analysis. |

### 3.2. Volatile Constituents (Essential Oil/GC-MC Analysis) [10][11]

**Table 6:** Volatile Constituents

| Compound Name | Phytochemical Class | Source/Part Used |
|---|---|---|
| (1R)-2,6,6- Trimethylsilyl [3.1.1] hept-2-ene | Monoterpene (Pinene Derivative) | Leaves (Essential Oil) |
| Bicycle [3.1.1] heptane,2,6,6-trimethyl-, (1S,2S,5R)- | Monoterpene (Pinene Derivative) | Leaves (Essential Oil) |
| Methyl p-coumarate | Phenolic Ester | Gum (Dichloromethane Fraction) – GC-MS |
| Phenol,4-(1,1,3,3-tetramethylbutyl)- | Substituted Phenol | Gum (Dichloromethane Fraction) – GC-MS |
| Cinnamic acid derivatives | Phenylpropanoids | Gum (Stem Bark) – GC-MS |

### 3.3. Extraction and separation techniques

*3.3.1. Solvent Extraction [8][11]*

This technique employs a liquid solvent to extract and isolate soluble constituents from the solid portions of plant material.

*3.3.2. Soxhlet Extraction*

- Description and Application: The Soxhlet extraction technique was employed to obtain crude plant extracts efficiently.

*3.3.3. Application:1*

- Ethanolic extracts of Syzygium aromaticum, Thymus vulgaris, and Eucalyptus globulus were prepared using the Soxhlet extraction technique.

*3.3.4. Application:2*

- The powdered plant materials of Hyptis suaveolens, Cymbopogon citratus, and Eucalyptus globulus were subjected to Soxhlet extraction with methanol as the solvent for a duration of 6–8 hours.

*3.3.5. Solvent Extraction (General)*

- Description and Application: It is recognized as one of the common techniques used for the extraction of essential oils.

### 3.4. Distillation Methods for Essential Oil: [11]

- These methods mainly rely on heat and subsequent condensation to isolate volatile essential oils from plant sources.

*3.4.1. Steam Distillation*

- Description and Application: This technique served as the primary method for evaluating the influence of leaf mass and moisture content of Eucalyptus globulus on the efficiency of essential oil extraction. In this process, steam is produced and directed through the plant material, allowing the essential oils to vaporize and mix with the steam. The resulting vapor mixture is then condensed to obtain the oil. Notably, this method operates without the use of organic solvents.

*3.4.2. Microwave-Assisted Hydro distillation*

- Description and Application: It is identified as one of the commonly applied techniques for extracting Eucalyptus essential oil (EEO). Both this method and steam distillation are known to produce comparatively higher extraction yields.

*3.4.3. Solvent-Free Microwave Extraction*

- Description and Application: It is identified as an alternative approach for the extraction of Eucalyptus essential oil (EEO).

*3.4.4. Other Extraction/ Isolation Techniques [4]*

- Ultrasound-Assisted Extraction
- Cold Pressing

*3.4.5. Supercritical Fluid Extraction*

- Description and Application: It is recognized as one of the techniques commonly employed for the extraction of essential oils.

*3.4.6. Fractionation and Quantification Techniques (Post-Extraction) [8]*

- These methods are applied after the initial crude extraction to separate, identify, and measure the individual chemical components.

*3.4.7. Column Chromatography*

- Description and Application: It is employed for the step-by-step separation of the crude extract. In this process, the methanol extract is passed through a silica gel column and eluted using a series of solvent mixtures with gradually increasing polarity.

*3.4.8. Thin Layer Chromatography (TLC)*

- Description and Application: It serves as a separation method, particularly for distinguishing colors, by utilizing the retention factor (Rf) to differentiate compounds.

*3.4.9. High Performance Liquid Chromatography (HPLC)*

- Description and Application: It is applied to measure the number of phytochemicals and key bioactive compounds present in the extracts.

*3.4.10. Gas Chromatography- Mass Spectroscopy (GC-MC) [11]*

- Description and Application: It is utilized to analyze and identify the chemical composition and molecular structure of eucalyptus oil.

### 3.5. Ethnopharmacological activities

*3.5.1. Traditional and Pharmacological Activities of Eucalyptus globulus [13]*

**Table 7:** Traditional and Pharmacological Activities of Eucalyptus globulus

| Pharmacological Activity | Model/Application | Active Compounds |
|---|---|---|
| Antimicrobial | Applied as an antiseptic and disinfectant for treating wounds, respiratory ailments, and for air purification. | 1,8-Cineole, Linalool, Borneol |
| Anti-inflammatory | Helps in reducing airway inflammation and suppressing cytokine activity in cases of bronchial asthma. | 1,8-Cineole |
| Antioxidant/ Antihistaminic | Hexane and ethanol extracts from leaves show inhibition of IgE-mediated histamine release. | Polyphenolic compounds |
| Analgesic / Stimulant | Acts as a mild stimulant and is used as an antiseptic mouthwash and cardiac tonic. | Eucalyptol, Cineole |
| Antidiabetic | Traditionally utilized for managing respiratory and metabolic health conditions. | — |
| Antimalarial / Insecticidal | Demonstrates antimalarial potential attributed to the presence of borneol, cineol, linalool, and geranyl acetate. | Terpenoids, Cineole derivatives |

### 3.6. Global Ethnobotanical, Ethnopharmacological Applications of Eucalyptus Species [3]

**Table 8:** Global Ethnobotanical, Ethnopharmacological Applications of Eucalyptus Species

| Region / Country | Traditional Use | Application Type | Inferred Pharmacological Activity |
|---|---|---|---|
| China | Fruits ("Anshu Guo") for cough and fever | Decoction | Antipyretic, Expectorant |
| Iran | Leaf decoction ("Okaliptus") for diabetes mellitus | Oral decoction | Antidiabetic |
| India | Oil ("Karpooramaram") for rheumatism, asthma, migraine, skin diseases | Topical / Inhalation | Anti-inflammatory, Analgesic, Antimicrobial |
| Pakistan | Decoction ("Sufaida") for asthma, cold, throat lozenges | Oral decoction | Antitussive, Decongestant |
| Bangladesh | Leaf ash pastes for allergy | Topical | Antihistaminic |
| Italy / Portugal / Greece / Spain | Used for malaria, diabetes, bronchitis, arthritis, influenza | Decoction / Infusion | Antimalarial, Anti-inflammatory, Analgesic |
| Nigeria / Morocco | Treatment for respiratory diseases, malaria, wounds, and diabetes | Leaf / Decoction | Antimicrobial, Antimalarial, Antidiabetic |
| Colombia / Brazil / Peru / Mexico | Used for asthma, bronchitis, rheumatism, sinusitis, and fever | Decoction / Infusion | Antiinflammatory, Antipyretic, Expectorant |
| Australia (Aboriginal use) | Indigenous preparations for respiratory ailments | Traditional remedy | Antimicrobial, Expectorant |

## 4. Fragrance And Aroma Chemistry of Eucalyptus Globulus

The distinctive aromatic nature of Eucalyptus globulus essential oil underpins both its therapeutic and industrial importance. This section explains the chemical origins of its characteristic scent, the major aroma-contributing compounds, and their influence on its value in fragrance formulation.

### 4.1. Aromatic Profile and Major Volatile Constituents: [14]

The essential oil of Eucalyptus globulus possesses a sharp, refreshing, and camphor-like fragrance with a mentholic undertone, which defines its sensory identity. This dominant aromatic impression is primarily due to the exceptionally high presence of 1,8-cineole (Eucalyptol), which forms the major component of the oil.

#### *4.1.1. Key Fragrance Components: [15][16][17]*

Being recognized as a "cineole species" (E. globulus Labill.), its aroma is primarily governed by Eucalyptol. Alongside this major compound, other volatile constituents such as monoterpenes — particularly α-pinene and β-pinene — also play a crucial role in shaping its fragrance profile. Moreover, oxygenated monoterpenoids like Citronellal, Citronellol, and α-Terpineol, though present in lesser concentrations, add depth and persistence to the overall bouquet of Eucalyptus oils.

#### *4.1.2. Variation by Species: [15]*

The olfactory properties of Eucalyptus oils vary with their chemotype. E. globulus typically produces an oil rich in 1,8-cineole (approximately 60–80%), giving it a strong, medicinal, and penetrating scent, which contrasts with other species dominated by α-phellandrene or piperitone.

#### *4.1.3. Effect of Extraction Techniques: [11][7]*

The extraction procedure significantly determines the oil's quality and aromatic intensity. While steam distillation and hydro-distillation remain the standard extraction methods, advanced approaches such as Microwave-Assisted Hydro distillation have been explored to enhance the yield and retention of key volatiles, leading to more concentrated aromatic fractions.

### 4.2. Industrial Relevance in Fragrance Formulation

The chemical and sensory properties of 1,8-cineole make Eucalyptus globulus oil a highly desirable raw material in the fragrance and cosmetic sectors.

#### *4.2.1. Commercial Applications: [15][17]*

Its invigorating, clean, and medicinal aroma contributes to its widespread utilization in perfumery (as a functional fragrance note), cosmetics (including balms, ointments, and skincare products), and aromatherapy, especially in respiratory preparations. Additionally, its incorporation into air fresheners and herbal deodorizing agents, such as odonil-type products, takes advantage of its antiseptic and refreshing attributes.

#### *4.2.2. Volatility, Stability, and Blending Properties: [14][17]*

Volatility: Owing to its high volatility, Eucalyptol functions as a strong top note, giving an immediate, crisp, and penetrating aroma when released.

Stability: The cyclic ether structure of 1,8-cineole confers notable stability compared to other volatile terpenoids such as aldehydes, ensuring its integrity during product formulation.

Blending Potential: Its versatile and clean aromatic profile allows it to blend effectively with numerous essential oils. It is frequently incorporated into formulations designed for therapeutic balms, respiratory care blends, and herbal fresheners to enhance the freshness and persistence of scent.

## 5. Industrial And Commercial Applications Of Eucalyptus Globulus

Eucalyptus globulus is a tall evergreen tree known for its diverse phytochemical constituents and long-standing traditional applications. [18] The essential oil (EO) derived from its leaves is commercially extracted in many regions and serves as a valuable industrial raw material. [18] Eucalyptus essential oils hold broad utility across pharmaceutical, cosmetic, and agricultural sectors. [20] The predominant bioactive compound, 1,8-cineole (eucalyptol) [18][19], contributes significantly to its antimicrobial and anti-inflammatory potential. [18] The distinct chemical profile of various plant parts makes them both nutritionally and therapeutically valuable. [19]

### 5.1. Commercial and Industrial Applications

The essential oil of Eucalyptus globulus finds wide-ranging applications across different industries:

### 5.2. Pharmaceutical (Balms, Inhalers, Antiseptics)

- Eucalyptus oil plays a vital role in phototherapeutic and pharmaceutical formulations. [20][18]
- Antiseptic Activity: The oil is recognized for its potent antiseptic characteristics, making it one of the most effective natural disinfectants. [19]
- Respiratory Care: Owing to its antiseptic and stimulant properties, it is used for alleviating minor respiratory disorders such as asthma and bronchitis. [18]
- Inhalation Therapy: As an inhalant, it supports respiratory relief in conditions like asthma and pharyngitis through the action of 1,8-cineole, which promotes easier breathing. [18]
- Balms and Therapeutic Use: Its aromatic constituents exhibit analgesic, antipyretic, and anti-inflammatory effects, which are incorporated into several therapeutic balm formulations. [18]

### 5.3. Cosmetic (Lotions, Soaps, Perfumes)

- The oil serves as a fundamental raw material in perfumery and cosmetic manufacturing. [20][18]
- Cosmetic Ingredient: Essential oils act as natural ingredients in perfumes and other personal care products. [20]
- Lotions and Hair Care: Formulations containing Eucalyptus extract have been shown to enhance hair texture, imparting improved shine and manageability. [18]

### 5.4. Household (Room Fresheners, Mosquito Repellents)

- The pleasant aroma and bioactive nature of Eucalyptus oil make it useful for domestic applications:
- Air Fresheners: The oil is frequently used in diffusers and nebulizers to refresh indoor air. [19]

- Insecticidal and Repellent Use: Its essential oil acts as a natural mosquito repellent and is incorporated into various insecticide and cleaning product formulations. [20][18]

### 5.5. Food Flavoring (in Trace Quantities)

- In minimal concentrations, Eucalyptus oil finds use in the food and beverage industry:
- Flavoring Agent: It serves as a raw material in the preparation of certain food flavorings and therapeutic beverages. [20][18]
- Functional Use: Apart from flavoring, its mild therapeutic attributes are sometimes utilized in food-based health applications. [20]

### 5.6. Challenges and Limitations (Disappointments)

- Despite its wide application potential, several factors limit the large-scale utilization of Eucalyptus essential oils:
- Standardization and Quality Issues: Variations in oil composition—caused by plant genetics, age, soil, and climatic conditions—complicate standardization efforts. [20]
- Toxicity Concerns: Overconsumption of Eucalyptus oil can result in toxic effects, necessitating controlled usage. [18]
- Formulation Instability: Enhancing the stability and bioavailability of essential oil-based formulations remains an ongoing challenge in product development. [20]

### 5.7. Safety aspects of eucalyptus globulus

Eucalyptus globulus, belonging to the family Myrtaceae, is a widely recognized medicinal plant across the world. Its essential oil, which contains a high concentration of 1,8-cineole (eucalyptol), exhibits strong antimicrobial, anti-inflammatory, and expectorant activities. These therapeutic properties make it highly valuable in pharmaceutical, cosmetic, and aromatherapy products. However, despite its medicinal potential, the plant and its essential oil can cause adverse effects when used in excessive doses, undiluted form, or through improper routes of administration. Hence, understanding the safe dosage limits, toxicity mechanisms, and necessary precautions for topical and inhalational use is crucial for ensuring both clinical and commercial safety of E. globulus preparations. [21][22][23][24]

#### *5.7.1. Safety in Topical Applications*

Topical use of eucalyptus oil is common in balms, creams, and massage preparations. The CIR Expert Panel reported that concentrations up to 2% are generally safe and non-irritating to normal human skin. [21]

Patch testing confirmed that such concentrations caused no erythema or sensitization. However, undiluted oil can lead to burning sensations, redness, dermatitis, or allergic responses in sensitive individuals. [21][22] The EMA recommends avoiding application near the noses or faces of infants and young children, as it can trigger reflex apnea or bronchospasm. It should also not be used on open wounds or mucosal tissues due to the risk of enhanced absorption and toxicity. [22] Eucalyptus oil is non-phototoxic and does not cause photosensitivity upon exposure to sunlight, making it suitable for both daytime and nighttime formulations. [21

#### *5.7.2. Safety in Inhalational Use*

Inhalation of eucalyptus vapor is widely practiced for its antiseptic and decongestant properties. A safe dose for steam inhalation is 3–5 drops (≈0.25 mL) in 150–250 mL of hot water for adults. [22]

- Properly diluted vapor provides short-term relief for cough and congestion and is well tolerated.

However, inhalation of highly concentrated vapor or essential oil aerosols can cause respiratory irritation, coughing, and bronchospasm, particularly in patients with asthma or chronic obstructive pulmonary disease (COPD). [22][24] High vapor levels may also cause CNS depression, drowsiness, or confusion due to systemic absorption of 1,8-cineole via the respiratory tract. [24] Sensitive groups such as infants, the elderly, and epileptic individuals may experience neurological effects like headache, weakness, and dizziness even at low concentrations, thus inhalational use should be limited to adults under controlled conditions. [21][22]

#### *5.7.3. Precautions and Contraindications*

- Both CIR and EMA documents recommend several safety measures for Eucalyptus globulus formulations

- Age restriction: Not recommended for children below two years due to the risk of respiratory blockage and CNS depression. [21][22]
- Pregnancy and lactation: Avoided due to insufficient safety data and possible systemic absorption [2].
- Medical conditions: Should not be used by individuals with liver disorders, asthma, epilepsy, or known sensitivity to essential oils. [21][22][24]
- Topical use: Must be diluted to ≤2% in a carrier oil and should not be applied to broken or inflamed skin. [21][22]
- Inhalational use: Limit use to a maximum of one week and ensure adequate ventilation. [22]
- Occupational safety: Workers handling large amounts should use gloves and respiratory masks to prevent skin and respiratory irritation. [21]

*5.7.4. Regulatory and Clinical Safety Perspective*

According to the CIR, Eucalyptus globulus–derived compounds are classified as "safe with qualifications," implying that they are acceptable for cosmetic and pharmaceutical use when applied within defined concentration limits and under proper dilution. [21]

The EMA monograph supports the use of eucalyptus leaf oil for temporary relief of mild respiratory ailments but emphasizes that self-medication should not exceed seven days. Oral administration is discouraged in children and pregnant women. [22]

## 6. Future Prospects of Eucalyptus Globulus Essential Oil

### 6.1. Future Prospects

*6.1.1. Ongoing developments point to several promising directions*

- **Greener extraction** – Solar and low-temperature distillation technologies should be scaled for industrial production to minimize energy use. [25]
- **Standardized GC–MS fingerprinting** – Harmonizing analytical profiles across growing regions will ensure consistent product quality. [16][26]
- **Nano-delivery systems** – Nano emulsions and encapsulated forms can enable long-lasting, skin-friendly, and environmentally safe fragrance and therapeutic products. [27]
- **Circular biorefinery model** – Simultaneous recovery of essential oils and triterpenes from Eucalyptus residues can enhance economic value while eliminating waste. [28]
- **Sustainable fragrance design** – Combining Eucalyptus oil with other natural essences may lead to innovative green perfumes and wellness blends with reduced synthetic content.[16][26]

## References

[1] Eucalypts Clonal Culture in India By Ravi Year: 2025 Container: Scribd URL:https://www.scribd.com/document/927881513/Eucalypts-Clonal-Culture-in-India

[2] Botanical descriptions of Eucalypti – ePrints By Leonard Rodway Year: 2017 Container: Utas.edu.au DOI: https://eprints.utas.edu.au/16229/1/1902-rodway-botanical_descriptins.pdf URL: https://eprints.utas.edu.au/16229/

[3] Jafari, F., Ramezani, M., Nomani, H., Amiri, M.S., Moghadam, A.T., Sahebkar, A., Emami, S.A. and Mohammadpour, A.H. (2021). Therapeutic Effect, Chemical Composition, Ethnobotanical Profile of Eucalyptus globulus: A Review. Letters in Organic Chemistry, [online] 18(6), pp.419–452. doi:https://doi.org/10.2174/1570178617999200807213043

[4] Google Scholar By Anon Year: 2025 Container: Google.co.in URL: https://scholar.google.co.in/scholar?q=Botany+of+Genus+Eucalyptus%E2%80%9D#d=gs_qabsandt=1762086824352andu=%23p%3DbRbw1WvKjp8J

[5] ChemInform Abstract: Phloroglucinols from the Leaves of Eucalyptus globulus.Tetsuro Kawabata, Tatsuya Hasegawa, Yuka Nojiri, Chiaki Uchida, Tomihisa Ohta Year: 2011 Container: ChemInform Publisher: Wiley Volume: 42 Issue: 31 DOI: 10.1002/chin.201131174 URL:https://www.researchgate.net/publication/264446702_ChemInform_Abstract_Phloroglucinols_from_the_

Leaves_of_Eucalyptus_globulus Credibility: nest_heat_link_e Probably credible Exploring the therapeutic benefits of Eucalyptus globulus Labill.: A five-year pharmacological review

[6] By Carolina Mayo Takahashi, Julio Chávez, Jorge Poemape Year: 2025 Container: Revista Colombiana de Ciencias Químico-Farmacéuticas Volume: 54 Issue: 3 Page: 679-688 DOI: 10.15446/rcciquifa.v54n3.117462 URL: https://revistas.unal.edu.co/index.php/rccquifa/article/view/117462

[7] Phytochemical analysis using GC-FID, FPLC fingerprinting, antioxidant, antimicrobial, anti- inflammatory activities analysis of traditionally used Eucalyptus globulus essential oil By Arun Dev Sharma, Mohit Farmaha, Inderjeet Kaur, Narveer Singh Year: 2021 Container: Drug Analytical Research Volume: 5 Issue: 1 Page: 26-38 DOI: 10.22456/2527-2616.110344

[8] Phytochemical Profiling and HPLC Quantification of Bioactive Compounds in Hyptis suaveolens, Cymbopogon citratus, and Eucalyptus globulus from Ebonyi State, Nigeria By Inya-Agha Somtochukwu Obiahu, Uka Job Ude, Ani Onuabuchi Nnenna Year: 2025 Container: Asian Journal of Applied Chemistry Research Publisher: Sciencedomain International Volume: 16 Issue: 4 Page: 56-67 DOI: 10.9734/ajacr/2025/v16i4355 URL:https://www.researchgate.net/publication/395831570_Phytochemical_Profiling_and_HPLC_Quantification_of_Bioactive_Compounds_in_Hyptis_suaveolens_Cymbopogon_citratus_and_Eucalyptus_globulus_from_Ebonyi_State_Nigeria

[9] Investigations of Phytochemical and Antibacterial Activity of Eucalyptus globulus Leaves from Al-Khums, Libya By Soad Belhaj, Afifa Omeman, Fouzy Alafid, Sumaia Aljarai, Salem Edrah Year: 2020 URL: https://www.researchgate.net/publication/340395375_Investigations_of_Phytochemical_and_Antibacterial_Activity_of_Eucalyptus_globulus_Leaves_from_Al-Khums_Libya

[10] Phytochemical Profiling, Cytotoxicity, and Antimicrobial Activities of Gum Extracts from the Stem Bark of <I>Eucalyptus globulus</I>

[11] By Muritala Salawu Kayode, Abiodun Shittu, Ngaitad Njinga Stanislaus, Shittu Olalere Year: 2025 Container: The Nigerian Journal of Pharmacy Volume: 59 Issue: 1 Page: 238-228 DOI: 10.51412/psnnjp.2025.22 https://www.researchgate.net/publication/392067071_Phytochemical_Profiling_Cytotoxicity_and_Antimicrobial_Activities_of_Gum_Extracts_from_the_Stem_Bark_of_Eucalyptus_globulus

[12] EXTRACTION OF ESSENTIAL OIL FROM EUCALYPTUS LEAVES (EUCALYPTUS GLOBULUS) BY STEAM DISTILLATION AND ITS PHYSICOCHEMICAL AND MICROBIOLOGICAL CHARACTERIZATION By Mercedes Puca Pacheco, Melanie Alisson, Guadalupe Neira, Alvaro Adrian, Frank Luis Year: 2024 Container: Revista de la Sociedad Química del Perú Publisher: Sociedad Quimica del Peru Volume: 90 Issue: 4 Page: 216-228 DOI: 10.37761/rsqp.v90i04.48 URL: https://www.researchgate.net/publication/391408798_EXTRACTION_OF_ESSENTIAL_OIL_FROM_EUCALYPTUS_LEAVES_EUCALYPTUS_GLOBULUS_BY_STEAM_DISTILLATION_AND_ITS_PHYSICOCHEMICAL_AND_MICROBIOLOGICAL_CHARACTERIZATION

[13] Antimicrobial activity, Phytochemical Screening of Crude Extracts, and Essential Constituents of Syzygium Aromaticum, Tymus Vulgaris and Eucalyptus Globulus on Selected Pathogens

[14] By Anon Year: 2024 Container: Microbial Bioactives Volume: 7 Issue: 1 DOI: 10.25163/microbbioacts.719791

[15] Takahashi T, Kokubo R, Sakaino M. Antimicrobial activities of eucalyptus leaf extracts and flavonoids from Eucalyptus maculata. Lett Appl Microbiol. 2004;39(1):60-4. doi: 10.1111/j.1472-765X.2004.01538.x. PMID: 15189289.

[16] Kaur P, Kaur K, Bhandari Dd, Joshi G. 1, 8-CINEOLE: A REVIEW. International Journal of Biology Pharmacy and Allied Sciences [Internet]. 2022 Nov 1;11(11):5306–14. Available from: https://www.researchgate.net/publication/365211086_1_8-CINEOLE_A_REVIEW

[17] View of Eucalyptus-based products range as an example of modern approaches to the creation of herbal drugs By Anon Year: 2025 Container: Uran.ua URL: https://journals.uran.ua/ami/article/view/324174/314833

[18] Čmiková N, Galovičová L, Schwarzová M, Vukic MD, Vukovic NL, Kowalczewski PŁ, et al. Chemical Composition and Biological Activities of Eucalyptus globulus Essential Oil. Plants. 2023 Feb 28;12(5):1076. https://pmc.ncbi.nlm.nih.gov/articles/PMC10004840/

[19] (PDF) A Review on Eucalyptus globulus: A New Perspective in Therapeutics [Internet]. ResearchGate. Available from: https://www.researchgate.net/publication/336825536_A_Review_on_Eucalyptus_globulus_A_New_Perspective_in_Therapeutics

[20] Rahul, Dahiya DP, Sankhyan A, Karan S. A review article on Eucalyptus plant and their pharmacological activities. Int J Pharm Sci. 2025;3(3):1994–2004. doi:10.5281/zenodo.15059223. https://www.ijpsjournal.com/article/A+Review+Article+on+Eucalyptus+Plant+and+Their+Pharmacological+Activities+

[21] An Review On Therapeutic Application Of Eucalyptus Oil Author's Name : Sneha Rajendra Fatangare*, Rani salve* Guide name : Kiran Kudale. [cited 2025 Nov 3]; Available from: https://ijprajournal.com/issue_dcp/An%20Review%20On%20Therapeutic%20Application%20Of%20Eucalyptus%20Oil.pdf

[22] Establishing a secure connection ... [Internet]. Scielo.br. 2025 [cited 2025 Nov 3]. Available from: https://www.scielo.br/j/abb/a/KDPkh4qRQSRq6Db8Wdw6psJ/

[23] Bergfeld W, Donald F, Belsito V, Hill R, Klaassen C, Liebler D, et al. Safety Assessment of Eucalyptus globulus (Eucalyptus)-Derived Ingredients as Used in Cosmetics [Internet]. [cited 2021 Apr 2]. Available from: https://www.cir-safety.org/sites/default/files/eucalyptus_1.pdf

[24] European Medicines Agency (HMPC). Assessment report on Eucalyptus globulus Labill., folium. EMA/HMPC/137423/2010. London: EMA; 2013. Available from: https://www.ema.europa.eu/en/documents/herbal-report/final-assessment-report-eucalyptus-globulus-labill-folium_en.pdf

[25] Hu Z, Feng R, Xiang F, Song X, Yin Z, Zhang C, et al. Original Article Acute and subchronic toxicity as well as evaluation of safety pharmacology of eucalyptus oil-water emulsions. Int J Clin Exp Med [Internet]. 2014 [cited 2025 Nov 3];7(12):4835–45. Available from: https://www.e-century.us/files/ijcem/7/12/ijcem0002667.pdf

[26] Ramya AK. 1,8-Cineole an Underappreciated Anti Inflammatory Therapeutic. International journal of pharmacognosy and Chinese medicine. 2023 Apr 25;7(1):1–6.Available from: https://www.medwinpublishers.com/IPCM/1-8-cineole-an-underappreciated-anti-inflammatory-therapeutic.pdf

[27] Sareriya KJ, Vanzara PB, Subarna Maiti. Optimization of Eucalyptus essential oil extraction by applying response surface methodology in traditional distillation and its adaption to solar thermal process. Sustainable energy research. 2024 Jul 9;11(1). https://sustainenergyres.springeropen.com/articles/10.1186/s40807-024-00118-y

[28] Abdessamad Ait benlabchir, Kawtar Fikri-Benbrahim, Moutawalli A, Alanazi MM, Asma Halmoune, Benkhouili FZ, et al. GC–MS Characterization and Bioactivity Study of Eucalyptus globulus Labill. (Myrtaceae) Essential Oils and Their Fractions: Antibacterial and Antioxidant Properties and Molecular Docking Modeling. Pharmaceuticals [Internet]. 2024 Nov 19;17(11):1552–2. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11597847/

[29] de Godoi SN, Quatrin PM, Sagrillo MR, Nascimento K, Wagner R, Klein B, et al. Evaluation of Stability and In Vitro Security of Nanoemulsions Containing Eucalyptus globulus Oil. BioMed Research International. 2017;2017:1–10. https://pmc.ncbi.nlm.nih.gov/articles/PMC5485270/

[30] Oliveira D, Moreira P, Cruz MT, Pereira F, Silva, Santos, et al. Exploiting the Integrated Valorization of Eucalyptus globulus Leaves: Chemical Composition and Biological Potential of the Lipophilic Fraction before and after Hydrodistillation. International Journal of Molecular Sciences. 2023 Mar 25;24(7):6226–6.https://pmc.ncbi.nlm.nih.gov/articles/PMC10094061/

[31] blickwinkel / Alamy Stock Photo. Eucalyptus globulus foliage. Paramount Plants and Gardens. Available from: https://www.paramountplants.co.uk/plant/egs/eucalyptus-globulus-standard.html [Accessed 3 November 2025].