

## A Basic Review on Eucalyptus Oil

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**ABSTRACT;** Eucalyptus (Eucalyptus spp.), an evergreen tall tree native to Australia and Tasmania, has been used since ancient times by the aboriginal population for several purposes. In particular, the species *E. globulus* is widely used in the pulp industry, as well as for the production of eucalyptus oil extracted on a commercial scale in many countries as raw materials in perfumery, cosmetics, food, beverages, aromatherapy and phytotherapy. The 1,8-cineole (eucalyptol), the principal and the most important constituent extracted from eucalyptus leaves, demonstrated an antimicrobial and anti-inflammatory activities. Despite the fact that the health effects of eucalyptus have been well established by research, further studies are necessary to investigate other prime effects of the plant and its possible implication in the treatment of a greater number of pathological conditions.

### I. INTRODUCTION

In recent decades, the demand for plant derived products for therapeutic uses has been increased [1]. In many countries worldwide aromatic herbs are used in primary health care, especially in rural areas [2], and 80% of the populations in developing countries use these traditional resources [3]. For this reason, the use of essential oils extracted from plants for clinical purposes have become an important topic in scientific research and industrial application thanks to the different biological activities of oils, which exercise antimicrobial [4], antioxidant [5] and anti-inflammatory [6] activities.

Eucalyptus (Eucalyptus spp.), is a large genus of the Myrtaceae family, which includes 900 species and subspecies. This evergreen tall tree is native from Australia and Tasmania and is the second largest genera after acacia [7]. Since

the 1850s, it has been successfully introduced into 90 countries worldwide where it is now one of the most important and widely planted genera [8]. In ancient times the eucalyptus plant was used for several purposes by aboriginal people, both as medicine and as food. Nowadays, the plant is used in forestry (timber, fuel, paper pulp), environmental planting (water and wind erosion control), as a source of essential oil (medicinal, perfumery oils), for arts and craft [7]. Among all the species of Australian Eucalyptus, the *E. globulus* was widely introduced overseas [9], becoming largely cultivated in the subtropical and Mediterranean regions [10], as well as in Nigeria. *E. globulus* which has different vernacular names (eucalyptus in Bengali and in Hindi; blue-gum eucalyptus in English and Karpuramaram in Tamil [11]), is considerably used in the pulp industry, as well as for the production of eucalyptus oil (henceforth EO), extracted on commercial scale in many countries and adopted in perfumery, cosmetics, food, beverages, aromatherapy and phytotherapy [12].

Eucalyptus plants draw the attention of researchers and environmentalists worldwide because it represents a fast-growing source of wood as well as a source of oil used for several purposes. The oil is extracted from leaves, fruits, buds and bark showing antibacterial, antiseptic, antioxidant, anti-inflammatory, anticancer activities [11,13] and for this reason used in the treatment of respiratory diseases, common cold, influenza, and sinus congestion [14,15]. The aim of this paper is to provide and collect scientific information about eucalyptus plants in order to present the beneficial and healthy properties and its potential use.



Fig.1 Eucalyptus Oil

## 1. INTRODUCTORY PROFILE

### 1.1 Synonyms

- Caswell No. 618A
- Dinkum oil
- EPA Pesticide Chemical Code 040503
- Essential eucalyptus oil
- Essential oils, eucalyptus
- Eucalyptus absolute (Eucalyptus globulus Labille)
- Eucalyptus citriodora oil
- Eucalyptus citriodora oil (Eucalyptus citriodora)
- Eucalyptus concrete (Eucalyptus globulus Lab.)
- Eucalyptus globulus oil
- Eucalyptus oil
- Eucalyptus oil (Eucalyptus globulus Labille)
- Eucalyptus terpene oil
- Eucalyptus oel
- Eucalyptus oel [German]
- FEMA No. 2466
- Oil eucalyptus globulus or macarthuri
- Oil of eucalyptus
- Oils, essential, eucalyptus
- Oils, eucalyptus
- Red gum
- UNII-2R04ONI662. [17]

### 1.2 Biological Source

Eucalyptus oil is the essential oil obtained by the distillation of fresh leaves of Eucalyptus globulus and other species like E. polybractea, E. viminalis, and E. smithii, belonging to family Myrtaceae [18].

### 1.3 Geographical Source

It is mainly found in Australia, Tasmania, United States, Spain, Portugal, Brazil, North and South Africa, India, France, and Southern Europe [18].

### 1.4 History

Eucalyptus globulus has been used since a long time for intermittent fever. The leaves and their preparations have been successfully used as a tonic, stimulant, stomachic, in dyspepsia, in catarrh of the stomach, in typhoid fever, in asthma, in whooping cough, etc. More recently it has been recommended as a diuretic in the treatment of dropsy [18].

### 1.5 Characteristics

Eucalyptus is a tall, evergreen tree, the trunk, which grows to 300 feet high or more, is covered with peeling papery bark. The leaves on the young plant, up to five years old, are opposite, sessile, soft, oblong, pointed, and a hoary blue colour. The mature leaves are alternate, petioled, leathery, and shaped like a scimitar. The flowers are solitary and white, without any petals.

Eucalyptus oil is a colourless or straw-coloured fluid, with a characteristic odour and taste, soluble in its own weight of alcohol. According to the British Pharmacopoeia Eucalyptus oil should contain not less than 55%, by volume of Eucalyptol, have a specific gravity 0.910 to 0.930, and optical rotation -10 degrees to 10 degrees [18].

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Dicotyledons
Subclass	Rosidae
Order	Myrtales
Family	Myrtaceae
Genus	Eucalyptus
Species	<i>Eucalyptus globulus Labill.</i>

1.6 Scientific Classification [19] Table:1

### 1.7 Vernacular Names

It has many Indian names, depending on the geographical region or the language, for

example: *Eucalyptus globulus* (Latin name), Tail Parn, Sugandh Patra (Sanskrit name), Gum Tree, Gum Eucalypt (English), Neelgir (Hindi), Nilgiri (Kannad), Harit Parn (Gujrati).

### 1.8 Major Species [20]

Major Species of Eucalyptus	Major Species of Eucalyptus
<i>Eucalyptus amygdalina</i>	<i>Eucalyptus microtheca</i>
<i>Eucalyptus australiana</i>	<i>Eucalyptus nitens</i>
<i>Eucalyptus botryoides</i>	<i>Eucalyptus ovate</i>
<i>Eucalyptus calophylla</i>	<i>Eucalyptus pauciflora</i>
<i>Eucalyptus camaldulensis</i>	<i>Eucalyptus perriniana</i>
<i>Eucalyptus citriodora.</i>	<i>Eucalyptus pilularis</i>
<i>Eucalyptus cladocalyx</i>	<i>Eucalyptus polyanthemus</i>
<i>Eucalyptus considiana</i>	<i>Eucalyptus polybractea</i>
<i>Eucalyptus cypellocarpa.</i>	<i>Eucalyptus populnea</i>
<i>Eucalyptus dives</i>	<i>Eucalyptus radiata</i>
<i>Eucalyptus gigantean</i>	<i>Eucalyptus regnans</i>
<i>Eucalyptus globulus</i>	<i>Eucalyptus risdonni</i>
<i>Eucalyptus gomphocephala</i>	<i>Eucalyptus robusta</i>
<i>Eucalyptus grandis</i>	<i>Eucalyptus rossi</i>
<i>Eucalyptus gunnii</i>	<i>Eucalyptus rostrata</i>
<i>Eucalyptus incrassate</i>	<i>Eucalyptus saligna</i>
<i>Eucalyptus kino</i>	<i>Eucalyptus sideroxylon</i>
<i>Eucalyptus largeflorens</i>	<i>Eucalyptus sieberiana</i>
<i>Eucalyptus lesouefii</i>	<i>Eucalyptus smithii</i>
<i>Eucalyptus macrocarpa</i>	<i>Eucalyptus tereticornis</i>
<i>Eucalyptus macrorhyncha</i>	<i>Eucalyptus tetradonta</i>
<i>Eucalyptus maculate</i>	<i>Eucalyptus umbra</i>
<i>Eucalyptus marginata</i>	<i>Eucalyptus urophylla</i>
<i>Eucalyptus melanophloia</i>	<i>Eucalyptus viminalis</i>
<i>Eucalyptus melliodora</i>	<i>Eucalyptus wandoo</i>

There are over 500 species of Eucalyptus. The major ones are enlisted below, (Table:2).

### 1.9 Microscopy

Eucalyptus leaf is isobilateral. Stomata are of anomocytic type and sunken, on both surfaces. Epidermal cells are polygonal with thick cuticle; anticlinal walls are straight on both surfaces. There are three to four layers of elongated palisade cells below each epidermis. Between these palisade regions, two to three layers of spongy parenchyma occur and some of its cells contain cluster and prismatic calcium oxalate crystals. Palisade regions

exhibit large subglobular oleoresin cavities. The midrib region shows no collenchymatous cells. Transverse section through the midrib region shows nearly uninterrupted arc of lignified pericyclic fibres just outside the vascular bundle [18].

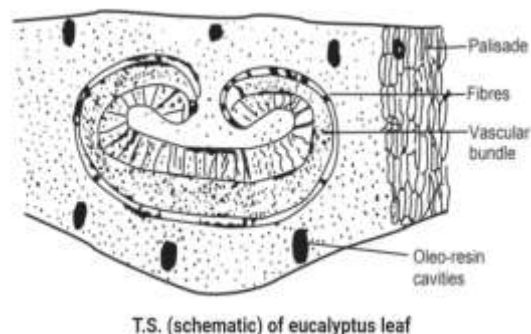


Fig.2 T.S (schematic) of eucalyptus leaf

### 1.10 Morphological Characters

The flower in bud are covered with a cup-like member (hence the name of the genus, derived from the Greek eucalyptus well covered), which is thrown off as a lid when the flower expands. The fruit is surrounded by a woody, cup shaped receptacle and contains numerous minutes' seeds. The first leaves are broad, without stalks, of a shining whitish-green and are opposite and horizontal, but after four or five years these are succeeded by other of a more sword-shaped form, 6 to 12 inches long, bluish-green in hue, which are alternate and vertical i.e. with the edges turned towards the sky and earth, and arrangement more suited to the climate and productive of peculiar of light and shade. The flower is single or in cluster, almost stalkless.

An adult eucalyptus may take the form of a low shrub or a very large tree. There are three main behaviors that species can divide into.

1. Woodland trees are single-stemmed even have a crown from a minor amount of the whole tree height.
2. Woodland trees are singled-stemmed even though they may branch at a small space above ground level.
3. Mallees are multi-stemmed from position level, usually less than 10m (33ft) in height.

Tree sizes follow the convention of:

- Small – to 10m (33ft) in height
- Medium-sized – 10-30 m (33-98ft)
- Tall – 30-60m (98-197 ft.)

- Very tall – over 60m (200ft) [21].

## 2. Plant at a Glance

### 2.1 Biological Description

#### Leaves

The Eucalyptus leaves are evergreen but some tropical species lose their leaves at the end of the dry season. Although mature Eucalyptus trees are usually towering and fully leafed [22].

#### Leaf colour

Dark green & dull green

#### Size of leaf

12.5 cm in length & 3.5 cm in breadth

#### Shape of leaf

Lanceolate & oblong

#### Venation of leaf

Pinnate [sec. Veins pairs oppositely]

### 2.2 Botanical Information

Species used: The family includes more than 500 species such as

E. biostatic: Southern Blue Gum, Eurabbie, Victorian Blue Gum

E. globules: Tasmanian Blue Gum

E. maiden: Maiden's Gum

Synonyms: Southern blue gum, Tasmanian blue gum, Maiden's gum

Category: Strong nervine and anxiolytic

Plants parts used: Leaf and Barks

### 3. Phytoconstituents

The essential oil of eucalyptus used in medicine is obtained by aqueous distillation of the fresh leaves. It is colorless or straw-colored fluid when properly prepared, with a characteristic odour and taste, soluble in its own weight of alcohol. The important constituents are Eucalyptol, present in E. globulus up to 70% of its volume [19].

### 4. Chemical Constituents

Eucalyptus oil contains volatile oil of which 70 to 85% is 1,8-cineole also known as eucalyptol. The other constituents present are p-cymene,  $\alpha$ -pinene; small quantity of sesquiterpenes like ledol, aromadendrene; aldehydes, ketones, and alcohols. It also has polyphenolic acids like ferulic acid, caffeic acid, gallic acid; flavonoids such as eucalyptin, hyperoside and rutin [18].

#### • Chemical Constituents of the Leaves of Eucalyptus Globulus

The essential oil consisted mainly of oxygenated monoterpenes, monoterpenes and oxygenated sesquiterpenes. Of these, 1, 8-

eucalyptus (72.71%)  $\alpha$ -terpinene (2.54%), terpinene-4-ol (0.34%), and linalool (0.24%) were the main oxygenated monoterpenes, while  $\alpha$ -eudesmol (0.39%), (-)-globulol (2.77%), and epilobulol (0.44%) were the main sesquiterpene. Several significant compounds were  $\alpha$ -terpineol acetate (3.1%), geranyl acetate (0.71%), Lpinocarveol (0.36%),  $\beta$ -sabinene (0.25%), and terpinolene (0.19%). A portion (0.26%) of the total constituents remains unidentified [23].

#### • Chemical Constituents in the Fruit of Eucalyptus Globulus

Fifteen compounds were obtained and identified as betasitosterol, betulinic acid, stigmasterol, euscaphic acid, 2ahydroxybetulinic acid, macrocarpol B, macrocarpal A, oleanolic acid 3,4,3 -O- trimethylelladic acid, 3-O-methylellagic acid 4-O-(2''-O-acetyl) – alpha-Lrhamnopyranoside, 3-O-methylellagic acid, ellagic acid and gallic acid [24].

#### • Chemical Constituents of the Wood of Eucalyptus Globulus

The main compound identified included sterols, sterol esters, fatty acid, steroid ketones, hydrocarbon and triglycerides. Minor compound such as fatty alcohol, mono- and diglycerides, waxes and tocopherols were also identified among the lipids from E. globulus wood. Sterols, sterol esters, fatty acids, steroid ketones, hydrocarbon and triglycerides were the major compound identified [25].

### 5. Types and Production

Eucalyptus oils in the trade are categorized into three broad types according to their composition and main end-use: medicinal, perfumery and industrial [26]. The most prevalent is the standard cineole-based "oil of eucalyptus", a colourless mobile liquid with a penetrating, camphoraceous, woody-sweet scent.

China produces about 75% of the world trade, but most of this is derived from camphor oil fractions rather than being true eucalyptus oil. Significant producers of true eucalyptus oil include South Africa, Portugal, Spain, Brazil, Australia, Chile and Swaziland [27].

Global production is dominated by Eucalyptus globulus. However, Eucalyptus kochii and Eucalyptus polybractea have the highest cineole content, ranging from 80-95%. The British Pharmacopoeia states that the oil must have a minimum cineole content of 70% if it is pharmaceutical grade. Rectification is used to bring lower grade oils up to the high cineole standard required. Global annual production of eucalyptus

oil is estimated at 3,000 tonnes. The eucalyptus genus also produces non-cineole oils, includes piperitone, phellandrene, citral, methylcinnamate and geranyl acetate [28]. Eucalyptus oil should not be confused with the term "eucalyptol", another name for cineole.

## 6. Uses of Eucalyptus oil

The oil is used as stimulant, antiseptic, flavouring agent, aromatic, deodorant, expectorant, antimicrobial, febrifuge, diuretic, and antispasmodic. It is also used in the treatment of lung diseases, sore throat, cold, as a vapour bath for asthma and various respiratory ailments and in bronchitis [18].

### • Medicinal and antiseptic

The cineole-based oil is used as component in pharmaceutical preparations to relieve the symptoms of influenza and colds, in products like cough sweets, lozenges, ointments and inhalants. Eucalyptus oil has antibacterial effects on pathogenic bacteria in the respiratory tract [29]. The Inhaled eucalyptus oil vapors are a decongestant and treatment for bronchitis [30]. Cineole controls airway mucus hyper secretion and asthma via anti-inflammatory cytokine inhibition. Eucalyptus oil also stimulates immune system response by effects on the phagocytes ability of human monocyte derived macrophages [31].

Eucalyptus oil also has anti-inflammatory and analgesic qualities as a topically applied liniment ingredient [32]. Eucalyptus oil is also used in personal hygiene products for antimicrobial properties in dental care [33] and soaps. It can also be applied to wounds to prevent infection [34].

### • Repellent and bio pesticide

Cineole-based eucalyptus oil is used as an insect repellent and biopesticide. In the U.S., eucalyptus oil was first registered in 1948 as an insecticide and miticide [35].

### • Flavouring

Eucalyptus oil is used in flavouring. Cineolebased eucalyptus oil is used as a flavouring at low levels (0.002%) in various products, including baked goods, confectionery, meatproducts and beverages [36].

### • Fragrance

Eucalyptus oil is also used as a fragrance component to impart a fresh and clean aroma in soaps, detergents, lotions and perfumes. It is known for its pungent [37].

### • Industrial

Research shows that cineole-based eucalyptus oil (5% of mixture) prevents the separation problem with ethanol and petrol fuel blends. Eucalyptus oil also has a respectable octane rating and can be used as a fuel in its own right. However, production costs are currently too high for the oil to be economically viable as a fuel [38]. Phellandrene- and piperitone-based eucalyptus oils have been used in mining to separate sulfide minerals via flotation.

### • Safety & Toxicity

If consumed internally at low dosage as a flavouring component or in pharmaceutical products at the recommended rate, cineole-based 'oil of eucalyptus' is safe for adults. However, systemic toxicity can result from ingestion or topical application at higher than recommended doses [39].

The probable lethal dose of pure eucalyptus oil for an adult is in the range of 0.05 mL to 0.5 mL/per kg of body weight [37]. Because of their high body surface area to mass ratio, children are more vulnerable to poisons absorbed transdermally. Severe poisoning has occurred in children after ingestion of 4 mL to 5 mL of eucalyptus oil [40].

## 6.1 Medicinal uses

### • Uses supported by clinical data

Short-term symptomatic treatment of mild states of anxiety or insomnia, due to nervousness, stress or tension.

### • Uses described in pharmacopoeias and in traditional system of medicine

To induce relaxation, reduce weight and treat fungal infection.

### • Uses supported by experimental data

Effective as local anaesthetic, antispasmodic, musculorelaxant, antimycotic, sedative and analgesic and neuroprotective effects.

### • Uses described in folk medicine, not supported by experimental or clinical data

Treatment of asthma, common cold, cystitis, gonorrhoea, headache, menstrual irregularities, UTI infection, and warts antidepressant, anti-stress [41].

## 6.2 General uses

### • Timber

Blue gum timber is yellow brown fairly heavy with an interlocked grain & is difficult to season. It can be used in construction, fence posts & poles.

- **Essential oil**

The leaves are steam distilled to extract eucalyptus oil. E. Globules are primary source of global eucalyptus oil production. Oil has therapeutic, perfumery, flavouring, antimicrobial & biopesticide properties [42].

- **Herb tea & honey**

Blue gum flower is considered a good source of nector & pollen for bees.

- **Phenolics**

Its bark contain quinic, caffeic acid, dihydroxyphenylacetic acid, myricetin, methylsuccinic acid & eucalbanin.

## 7. Therapeutic Application

Eucalyptus (Myrtaceae) is one of the world most importance and most widely planted genera. In Australia, this genus is the second largest genus, after Acacia, and contains about 750 species. UAs an expectorant for symptomatic treatment of mild inflammation of the respiratory tract and bronchitis. Also for symptomatic treatment of asthma, fever and inflammation of the throat describe in pharmacopoeias and in traditional systems of medicines. Treatment of cystitis, diabetes, gastritis, kidney, disease (unspecified), laryngitis, leucorrhoea, malaria, pimples, ringworm, wounds, ulcers, of the skin, urethritis and vaginitis uses described in folk medicines, but not supported by experimental or clinical data [43].

### 7.1 Air Fresheners

Most of eucalyptus oils are in aroma lamps, electric room diffusers, and spray mists. To make a simple mist spray, Dilute 50 to 100 drops or so of essential oils in 4 fluid ounce (120ml) of pure water. Spray to refresh and cleanse the air [44].

### 7.2 Allergy

Eucalyptus is used in many of allergies [44].

- **Bronchitis:** A nagging cough that lingers and causes difficulty in breathing is often symptomatic of bronchitis.
- **Congestion:** Congestion in the airways, lungs, sinus and chest makes breathing difficult and being sick even more miserable.
- **Sinus:** The cold that linger may not be just a cold. The congestion and headache may be sings of a sinus infection.
- **Asthma:** Eucalyptus has been shown to help ease breathing in asthma.

### 7.3 Antiseptic

The medicinal Eucalyptus oil is probably the most powerful antiseptic of its class, especially when it is old, as ozone is formed in its exposure to the air. It has decided disinfectant action, destroying the lower form of life [45].

### 7.4 Stimulant

Eucalyptus oil is used as a stimulant and antiseptic gargle. Locally applied, it impairs sensibility. It increases cardiac Action [45].

### 7.5 Antimalarial

Its antiseptic confers some antimalarial action, though it cannot take place of Cinchona [46].

### 7.6 Anthelmintic action

For some years Eucalyptus- chloroform was employed as one of the remedies in the tropics for hookworm, Due the presence of phyto chemical constituents such as borneol, cineol, linalool, gernayl acetate, saffrol, antheol due to which it exhibits anthelmintic action of different intestinal worms [46].

### 7.7 Spasmodic action

In croup spasmodic throat troubles, the oil may be freely applied externally [47].

### 7.8 UTI and RTI Infection

An emulsion made by shaking up equal parts of the oil and powdered gum-arabic with water has been used as a urethral injection, and has also been given internally in draxhum doses in pulmonary tuberculosis and other microbic diseases of the lungs and bronchitis [47].

### 7.9 Irritant action and parasitic Infection

In large doses, it acts as an irritant to the kidneys, by which it is largely excreted, and as a marked nervous depressant ultimately respiration by its action on the medullary center. In veterinary practice. Eucalyptus oil is administered to hores in influenze, to dogs in distemper, to all animals in septicemia. It is also used for parasitic skin affections [47].

### 7.10 Anti-inflammatory

1, 8-cineole, major constituents present in violate oil of Eucalyptus airway inflammation in bronchial asthma and other steroid-sensitive disorders [48].

### 7.11 Antihistaminic

Hexane extract of leaves, ethanol extract of fruits & leaves of *Eucalyptus globulus* inhibited IgE dependent histamine release from RBL-2H3 cells [49].

### 7.11 Antiviral

Twelve euglobals from *Eucalyptus globules* & their twenty-six related compounds were examined for their inhibitory effects on Epstein-Barr virus activation by a short term in vitro assay. The results showed the most of the euglobals having monoterpene structures, & euglobal-III had strong inhibitory activity. Grandinol, homograndinols showed stronger inhibitory effects [50].

### 7.12 Antitumor

Antitumor-promoting activity of Euglobals Ia1, Ia2, Ib, Ic, IIa, IIb, IIc, III, IVa, IVb, and V and VII was tested in vitro on 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced EpsteinBarr virus early antigen (EBV-EA) activation test system. Euglobal-III showed strong inhibitory activity, followed by euglobals Ib, IIa, Ic, Ia1, Ia2. *Eucalyptus globulus* oil inhibits the nuclear translocation of NF-kappa B induced by LPS in THP-1 cells [51].

### 7.13 Antifungal

Treatment of human facial demodicidosis with freshly prepared camphor oil (*Eucalyptus globulus*) with or without glycerol dilutions gave complete cure with concentrations of 100%, 75%, and 50%. *Eucalyptus globulus* leaf extracts and oil showed antifungal property as they progressively inhibited the growth of *Malassezia furfur* on Sabouraud's dextrose agar medium [52].

### 7.14 Antibacterial

A 50% Ethos extract of *Eucalyptus globules* leaves yielded eight phloroglucinol-sesquiterpene-coupled constituents, including three novel compounds named macrocarpals, H, I and J. Some of these compounds possessed anti-bacterial activity against oral pathogenic microorganism with MIC values ranging from 0.20µg/ml to 6.25µg/ml. A 50% EtOHsoluble materials was extracted from the dried leaves of *E. globulus*. The extract showed appreciable antibacterial activity against *S. Mutans* Ingbritt & *P. gingivalis* ATCC 33277 (causes dental caries & periodontal

disorders) using the broth dilution method (MICs were 12.5 & 6.25µg/mL, respectively) [53].

### 7.15 Antiviral

Euglobal -G1, -G2 and -G3 strongly inhibited the EpsteinBarr virus activation. Euglobal -G1 -G5 isolated from leaves of *Eucalyptus grandis* exhibited significant inhibitory effects on Epstien-Berr virus (EBV) activation induced by the tumor promoter, 12-O-tetradecanoylphorbol-13-acetate (TPA) [50].

### 7.16 Anticancer

Phlorogruicinol-monoterpene derivative, euglobal-G1 (EG-1), was obtained from the leaves of *Eucalyptus grandis* as an active constituent inhibited the promotion stages on two-stagecarcinogenesis induced by both TPA-type & non TPA-type promoter (fumonis B 1) and inhibited the pulmonary tumorigenesis induced by 4-NQO & glycerol. Therefore, EG-1 might be valuable as a chemo protective agent in chemical carcinogenesis [50].

### 7.17 Hepatoprotective

Ursolic acid isolated from the leaves of *Eucalyptus hybrid E.tereticomis* showed a dose dependent (5-20 mg/kg) hepatoprotective activity (21-100%) in rats against thioacetamide, galactosamine and carbon tetrachloride induced hepatotoxicity in rats [54].

## 8. PHARMACOLOGICAL ACTIONS

Various Pharmacological activities reported in this plant such as diabetic, inflammation, malarial, bacterial infection, neurological disorder and other CNS disorder (epilepsy, depressant etc).

### In vitro and animal studies

#### Anti-inflammatory effect

Results show that pre-treatment with *E. globules* extracts significantly inhibits iNOSmRNA expression. This study thus suggests that the inhibition of net NO production by these two extracts may be due to their NO scavenging activity and/or their inhibitory effects on iNOS gene expression.

#### Antibacterial effect

These results suggest that further studies to clarify the possible therapeutic role of *E. Globules* leaf extract in the treatment of respiratory tract infection are warranted [55].

### Neurophysiologic effect

The effects eucalyptus oil preparations on neurophysiologic, psychological and experimental algesimetric parameters were investigated in 32 healthy subjects in a double-blind, placebocontrolled, randomized cross-over design. Four different test preparations were applied to large areas of the forehead and temples using a small sponge and their effect were evaluated by comparing baseline and treatment measure. Eucalyptus oil and ethanol increased cognitive performance and had a musclerelaxing and mentally relaxing effect, but had little influence on pain sensitivity [56].

### Antidiabetic effect

The leaves of Eucalyptus globulus are used for the treatment of diabetes mellitus in traditional medicine. The aim of this study was to evaluate the effects of eucalyptus on streptozotocin induced damage in pancreatic islands by stereological methods. The result suggested that Eucalyptus globules with a dose dependent manner ameliorates diabetic states by partial restoration of pancreatic beta cells and repair of STZ- induced damage in rats. The study suggests a beneficial effect of eucalyptus in the treatment of diabetes [57].

### Antioxidant effect

Crude extract from fruit of Eucalyptus globules was screened for its in vitro antioxidant properties. These results suggest that fruits of E. globulus have interesting antioxidant activities [58].

### Anthelmintic Activity

It was found that oil inhibited the radicals to about 68% and it kill the earth worms at 37min at the highest concentration (100g/ml v/v).

### Synergistic effect

The use of this compound of Eucalyptus globulus may represent an important source of bioactive compounds and an alternative for the treatment of respiratory infectious disease caused by P. Aeruginosa.

### Lipid Per oxidation effect

The results indicate that the aqueous extract of E. globulus leaves may have deleterious effects on liver membrane structure and functional integrity.

### Anticancer effect

Methanolic crude extracts of Eucalyptus globulus and Tinosopra Cordifolia grown in natural and industrial polluted condition were investigated for their anticancer activity against MCF-7 breast cancer cell lines to study the pollution effect on cytotoxicity [59].

## II. CONCLUSION

In conclusion, studies conducted on eucalyptus plant demonstrated its biological activities, due to the multitude of compounds contained in the leaves, stem and roots [60,61]. In particular, the abundance of bioactive secondary metabolites, such as terpenoids, tannins, flavonoids, and phloroglucinol derivatives confers both the antiviral and antibacterial effects [62] that explain the traditional use of the plant as an antiseptic and in the treatment of respiratory tract infections. Among the genus Eucalyptus, the species E. globulus is the most widely cultivated in the subtropical and Mediterranean regions, which reach a therapeutic importance thanks to its phytochemicals compounds. However, despite the several known healthy effects of eucalyptus plant, further studies are necessary to investigate other prime effects of the plant and the possible implication in the treatment of other pathological conditions, and in case of plant toxicity, the diffusion of injuries prevention strategies. A variety of Eucalyptus species have also been widely studied for their various therapeutics activities, like Analgesic, Antiviral, AntiInflammatory, Antibacterial, Antidiabetic, Antioxidative, Antitumor, Antihistaminic, Anticancer, and hepatoprotective properties. In present review, we have made an attempt to congregate the description, phytochemical, therapeutics application and information on Eucalyptus species.

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