

RESEARCH ARTICLE

GC-MS Analysis of Essential Oil from the Leaves of *Hyptis suaveolens* Identifies Bioactive Phytochemicals with Antioxidant Activity

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ABSTRACT

Essential oils have been identified for their vital relevance and uses in many areas, ranging from pharmaceutical, medicinal, food flavouring, and preservation. Essential oils' potency and viability for various applications are attributed to the constituent bioactive compounds, which constitute their active agents. Essential oils are mainly isolated and recovered from plant substrates by adopting different extraction methods. This study extracts the essential oil from *Hyptis suaveolens* leaves using the Cleventure apparatus. The oil extracted was analysed for antioxidant activity and subjected to GC-MS analysis. The results indicated the antioxidant power of essential oil, and the compounds identified through GC-MS analysis were reported to contain numerous biological activities.

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INTRODUCTION

Plants and other natural sources can provide many complex and structurally diverse compounds. Plant medicinal properties have received great interest because of their pharmacological activities, economic viability, and low toxicity. It is estimated that there are 250,000 to 500,000 species of plants on Earth. A relatively small percentage (1 to 10) of these is used as food by humans and other animal species. It is possible that even more are used for medicinal purposes ¹.

Recently, studies have focused on exploring the benefits of plant-extracted phytochemicals and their effect on human health. There has been an increase in the food industry's interest in natural compounds for direct addition or use in synergy with other compounds. Natural additives from plants can be compounds, groups of compounds, or essential oils. Plant extracts

and essential oils possess antifungal and antibacterial properties and have been screened globally as potential sources of novel antimicrobial compounds, promoting food preservation and alternatives to treat infectious diseases ².

Essential oils (EOs) contain unique aromatic compounds that give each essential oil its characteristic essence. They are extracted from various plant parts, such as wood, leaves, roots, flowers, and fruits, using steam or hydro-distillation techniques and mechanical methods, such as cold pressing. These oils are complex combinations of terpenic chemicals, mainly monoterpenes and sesquiterpenes, and alcohols, aldehydes, ethers, esters, ketones, and phenols, contributing to their distinctive scents. Being natural mixtures of very complex nature, essential oils contain more than 200 chemical components, but

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some are many times more complex. Among them, two or three major compounds are usually present at relatively high concentration (20-70) compared to other components present in trace amounts. The amount of the different components of essential oils varies amongst different plant parts and different plant species. They can be essentially classified into two groups: *Volatile fraction*: Essential oil constituting of 90-95 percentage of the oil in weight, containing the monoterpene and sesquiterpene hydrocarbons, as well as their oxygenated derivatives along with aliphatic aldehydes, alcohols, and esters. *Nonvolatile residue*: This comprises 1-10% of the oil, containing hydrocarbons, fatty acids, sterols, carotenoids, waxes, and flavonoids³.

The biological activities exhibited by essential oils derived from aromatic and medicinal plants have garnered significant interest due to their ability to scavenge free radicals. Various diseases, including cancer, the decline of food quality, and neurodegenerative disorders, have been linked to free radicals. Research indicates that directly incorporating essential oils and extracts from aromatic plants into food products can provide antioxidant and antimicrobial benefits. These essential oils demonstrate considerable antibacterial, antiparasitic, antifungal, and insecticidal properties. Consequently, essential oils can be an effective means of combating bacterial resistance. Specifically, the antimicrobial properties of plant oils and their extracts have led to numerous applications in areas such as food preservation, pharmaceuticals, alternative medicine, and natural therapies².

Essential oils are most commonly used in the practice of [aromatherapy](#). During inhalation, they directly go from the olfactory system to the limbic system of the brain, which plays a role in controlling emotions, behaviours, sense of smell, and long-term memory. The limbic system also plays a role in controlling several unconscious physiological functions, such as breathing, heart rate, and blood pressure, hence helping in promoting mental clarity, relaxation, and stress relief. It is easily absorbed when applied to the skin and carried throughout the body via the circulatory system and reaches all internal organs⁴.

In the pharmaceutical industry, essential oils have versatile applications⁵ as detailed below.

Antiseptics: Essential Oil's antiseptic properties make them active against a wide range of bacteria as

on antibiotic-resistant strains. In addition to this, they are also effective against fungi and yeasts. The most common sources of essential oils used as antiseptics are: Cinnamon, Thyme, Clover, Eucalyptus, Culinary Savory, and Lavender. Citral, geraniol, linalool, and thymol are more potent than phenol.

Expectorants and diuretics: Essential oils increase microcirculation and provide a slight local anesthetic action when used externally. Essential oils are used in several ointments, creams, and gels, which are known to be very effective in relieving sprains and other articular pains. Oral administration of essential oils like eucalyptus or pine oils stimulates ciliated epithelial cells to secrete mucus. On the renal system, these are known to increase vasodilation and consequently bring about a diuretic effect.

Spasmolytic and sedative: Essential oils from the Umbelliferae family, Mentha species, and Verbena are reputed to decrease or eliminate gastrointestinal spasms. These essential oils increase the secretion of gastric juices. In other cases, they are known to be effective against insomnia.

In addition, they have been used to treat stress and anxiety, headaches and migraines, to improve the sleep quality of women after birth, and exert anti-inflammatory effects.

A *Clevenger apparatus* method for essential oil extraction was first developed in the Middle Ages by Arabs, and is the most common method for commercially obtaining essential oils. Essential oils are volatile liquids since their density is lower than water. They are rarely coloured and soluble in organic solvents. An important characteristic of essential oils and their components is hydrophobicity, which enables them to partition with the lipids in the cell membrane of bacteria and mitochondria, rendering them more permeable by disturbing the cell structures. This eventually results in the death of the bacterial cell due to leakage of critical molecules and ions from the bacterial cell to a great extent. Some compounds modulate drug resistance by targeting efflux mechanisms in several species of Gram-negative bacteria. Health, Human, and Public Health services have recognized essential oils as safe substances that can be antibacterial additives⁶.

Hyptis is a genus belonging to the mint family (Lamiaceae) that includes approximately 300 species⁷

and is native to the tropical and subtropical regions of the Americas⁸. *Hyptis suaveolens* is an upright, annual or short-lived perennial herbaceous plant that typically reaches heights of 1 to 1.5 meters. The leaves, measuring between 2 and 10 cm in length and 1 and 7 cm in width, are arranged oppositely. The flowers are small, ranging from 5 to 7 mm long, and exhibit colors such as pink, bluish-purple, or lavender⁹. This species is indigenous to the Neotropics, from Central America and the West Indies to approximately the tropic of Capricorn. It has been introduced to various tropical and subtropical regions worldwide, including certain Pacific Islands, where it has become extensively naturalized. It is identified as a perennial herb that proliferates rapidly in dense clusters in various environments, including roadsides¹⁰. Currently, *H. suaveolens* is recognized as a prevalent invasive weed globally. It is recognized as an invasive species in regions such as Hawaii, Guam, Niue, Papua New Guinea, the Philippines, Singapore, and Taiwan¹¹. According to GBIF¹², it is also deemed invasive in some regions of Africa and South Asia. This species has been identified as one of the most significant invasive threats in the highlands of West-Central India⁸.

The present study aimed to analyse the phytochemicals in water extract and the extraction of essential oil from the leaves of *Hyptis suaveolens* (L), and also to reveal its chemical constituents using GC-MS and assess its antioxidant activity.

Table 1: Scientific Classification

Kingdom	Plantae
Family:	Lamiceae
Genus:	Hyptis
Species:	H. suaveolens
Binomial name	Hyptis suaveolens (L.) Poit. 1806



Figure 1. Hyptis suaveolens

MATERIALS AND METHODS

Collection of Plant material:

The plant materials for the proposed study, *Hyptis suaveolens*, were collected from Kolumam, Tirupur district, Tamil Nadu, India. The plant was authenticated by Dr. C. Murugan, Botanical Survey of India, TNAU campus, Coimbatore, with the voucher number BSI/SRC/5/23/2018/Tech. 3328.

Phytochemical screening

Phytochemical screening checks the presence or absence of secondary metabolites in a sample. The sample extracted with water was used for the analysis, following the standard protocol by Trease and Evans¹³.

Essential oil extraction

Clevenger apparatus

The Clevenger apparatus functions based on the principle of steam distillation followed by separation according to density. Plant material is heated in the presence of water, which leads to the vaporization of essential oils alongside the steam. The vapor subsequently condenses, and since the essential oil is less dense than water, it rises to the surface, facilitating straightforward separation and collection. Essential oils comprise compounds with boiling points reaching up to 80 °C or higher. In the Clevenger apparatus, these compounds are volatilized near 50 °C, under atmospheric pressure.

The experimental setup is shown in Figure 2. Clevenger's Apparatus consists of one round bottom flask of 1000ml, which is connected to another two-way round flask that holds raw material. The top flask is connected with the condenser through the connector.

Extraction process

Fresh leaves of *Hyptis suaveolens* (200 g) are cut into pieces less than 2 X 2 cm immediately after collection and placed in the still with boiled with 500 ml of distilled water and the apparatus allows the passage of the herb material under pressure which softens the cells and allows the essential oil to escape in vapor form. Besides the Clevenger, the tiny droplets of essential oil evaporate and travel through a tube into the still's condensation chamber, where essential oil vapors condense in the Clevenger apparatus. The essential oil forms a film on the surface of the water, oil distillation ceased after 5-6 hrs. The separating funnel is used to separate essential oil and water.



Figure 2: Extraction of essential oil using the Clevenger apparatus

The volume of essential oils was determined from a calibrated trap. The essential oils in the distillate were dried over anhydrous Na₂SO₄ and kept in the freezer. The yield was calculated as prescribed by Aguele *et al.*,².

Extraction

$$\text{Yield (\% v/w)} = \frac{\text{Volume of extracted essential oil}}{\text{Mass of dried material extracted}} * 100$$

Analysis of Essential Oils:

Antioxidant activity

The essential oil was analysed for its antioxidant activity using the reducing power assay¹⁴ and DPPH radical scavenging activity¹⁵.

Gas Chromatography - Mass Spectroscopy (GC-MS) analysis

The oil was also analysed using Gas Chromatography with Mass Spectrometry to know the composition of the oil and the quantity of each component. It is a method that combines the features of gas-liquid chromatography and mass spectrometry to identify different substances within a test sample.

GC-MS analysis of the essential oil was performed using the equipment, Thermo GC-Trace Ultra Version: 5.0, Thermo MS DSQ II. The equipment has a DB-35-MS Capillary Standard Non-polar column with dimensions of 30 m x 0.25 mm ID x 0.25 µm Film. The carrier gas used is Helium with a flow of 1.0ml/minute. The injector was operated at 250°C, and the oven temperature was programmed as follows: 60

°C for 15 minutes, then gradually increased to 280°C for 3 minutes. The identification of components was based on a comparison of their mass spectra with those of Wiley and NBS libraries, as well as a comparison of their retention indices. The constituents were identified after comparison with data available in the computer library (NIST -National Institute of Standards and Technology database) attached to the GC-MS instrument, and the results obtained have been tabulated.

RESULTS AND DISCUSSION

Phytochemical screening of *Hyptis suaveolens* leaf

The results of phytochemical screening are tabulated in Table -1. The table shows that the *H. suaveolens* leaf is a rich source of phytochemicals.

Table -2: Phytochemical screening of *Hyptis suaveolens*

Solvent	AL	FL	TN	CG	SA	OF	TP	ST
Water	+	+	+	-	+	+	+	+

Al-Alkaloids; FL-Flavonoids;TP-Tannin and phenolic compounds; CG-Cardiac glycosides; Sa-Saponins; OF-oil and Fats; TP- Terpenoids ; ST- Steroids

“+” - Present “-” - Absent

Terpenoids, phenols, flavonoids, steroids, alkaloids, tannins, and saponins were the phytochemicals. Phytoconstituents such as tannin, quinine, terpenoid,

flavonoid, steroid, alkaloid, cardiac glycoside, glycoside, and volatile oils have been identified in various plants. Flavonoids have been linked to a decreased risk of cardiovascular diseases and cancer, and serve as effective antibacterial agents. Certain classes of phytochemicals, including flavonoids, alkaloids, and tannins, have demonstrated cytotoxic effects. Furthermore, saponins are recognized for their cholesterol-lowering effects, cytotoxic characteristics, and antibacterial and antiviral properties. Tannins exhibit anticancer properties, as evidenced by their inhibitory effects on growth¹. Alkaloids have a wide range of pharmacological activities, including antimalarial, antiasthma, anticancer, vasodilatory, analgesic, antibacterial, and antihyperglycemic activities. Plant terpenoids are used for their aromatic qualities and play a role in traditional herbal remedies. They have strong antimicrobial qualities, antispasmodic, smooth muscle relaxant, antipruritic, and pheromonal effects in insects.¹⁶

Essential oil - extraction, biological activity assessment, and analysis

EOs Yield

The Clevenger apparatus method of extraction is a special type of extraction or a separation process for temperature-sensitive materials like oils, hydrocarbons, etc., which are insoluble in water and may decompose at their boiling point. The fundamental nature of Clevenger extraction is that it enables a compound or mixture of compounds to be extracted at a temperature substantially below that of the boiling point(s) of the individual constituents.

The essential oil yield from *H. suaveolens* was 0.6 mL from 200 g of fresh leaves, which is calculated as 0.3 %. Several factors determine the final quality of an essential oil. Apart from the plant material, the most important factors are time, temperature, pressure, and the quality of the extraction equipment. Essential oils are very complex products. It is reported that longer extraction times may give more complete oil with improved odour, with added pleasantness.

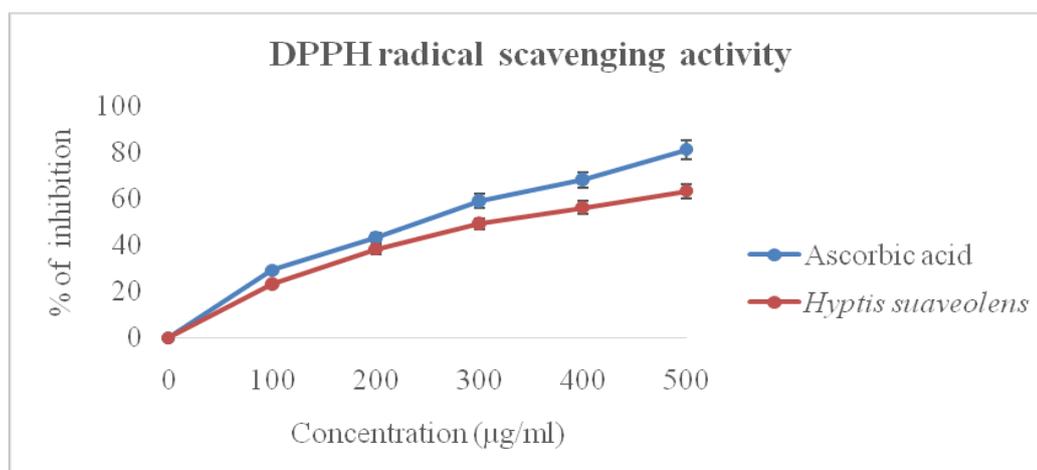
In vitro free radical scavenging activity

Phytochemicals and antioxidant constituents in plant material have raised interest among scientists, food manufacturers, producers, and consumers for their roles in maintaining human health¹⁷.

DPPH radical scavenging activity

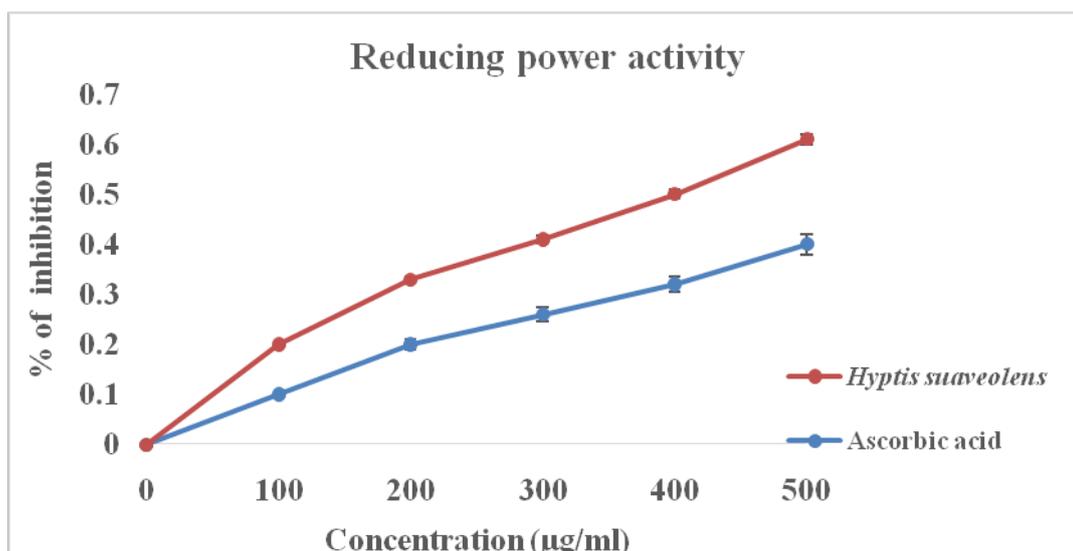
Numerous natural antioxidants have been identified in plants, demonstrating significant free radical scavenging properties. The ability to scavenge DPPH free radicals is extensively utilized to assess the antioxidant potential of plant extracts. Antioxidants are believed to play a crucial role in disease protection by their capacity to neutralize free radicals within biological systems. The DPPH assay is among the most commonly employed techniques for evaluating the antioxidant activity of plant extracts¹⁸.

The decrease in its absorbance determined the reduction capability of DPPH radical. Figure 3 illustrates a significant decrease in the DPPH radical due to the scavenging ability of the extract. The essential oil extract showed maximum activity of 63% at 500 µg/mL, whereas ascorbic acid at the same concentration



The values are expressed as mean ± SD of triplicate

Figure 3. DPPH radical scavenging activity of Essential oil extract of *Hyptis suaveolens*



The values are expressed as Mean \pm SD of triplicate

Figure 4: Reducing power activity of Essential oil extract of *H. suaveolens*

exhibited 81% inhibition. The IC₅₀ values were found to be 348.68 µg/mL for essential oil extract and 272.95 µg/mL for ascorbic acid, respectively.

Reducing power activity

The reducing capacity of a compound may serve as a significant indicator of its potential antioxidant activity. Fe (III) reduction is often used as an indicator of electron-donating activity, an essential mechanism of phenolic antioxidant action. The reducing ability of a compound generally depends on the presence of reductones (antioxidants), which exert the antioxidant activity by breaking the free radical chain by donating a hydrogen atom¹⁹.

The standard curve of ascorbic acid and the essential oil extract of *Hyptis suaveolens* was shown in figure, and the essential oil extract of *Hyptis suaveolens* was shown in Figure 3. The *Hyptis suaveolens* essential oil extract's ability increases with increasing concentration (100-500 µg/mL), like the antioxidant activity of the standard curve. An earlier study by Tanaka *et al.*, has reported a direct correlation between antioxidant activity and reducing power of certain plant extracts.

The assay for reducing power is predicated on converting ferric ions (Fe³⁺) to ferrous ions (Fe²⁺), which is detected by an increase in absorbance measured spectrophotometrically at 700 nm. This increase in absorbance correlates with higher concentrations of the extracts, indicating enhanced reducing power. A prior study by Oyaizu¹⁴ corroborated

this transformation, suggesting it may be attributed to the phytochemicals present in the plant extracts. Furthermore, the reducing properties of these extracts are typically linked to the presence of reductones, which have demonstrated antioxidant capabilities by interrupting free radical chains through hydrogen atom donation. The reducing power of the essential oil extract from *Hyptis suaveolens* increased progressively with higher extract concentrations.

Essential oil and the extracts of *H. suaveolens* and other plants have been acclaimed by researchers to have antioxidant activities, with medicinal values exploited in the treatment of degenerative diseases.^{21,22}. This has implied effects on the importance and uses of essential oils in food and allied industries, as aromas, flavouring substances, and preservatives²³. The antioxidant activities of EOs were attributed to the presence of eugenol and methyl eugenol as the active agents

Antimicrobial activity studies of essential oil from *H. Suaveolens* leaves significantly affected bacterial strains like *Staphylococcus aureus* (a gram-positive bacteria strain) than the gram-negative bacterial strains²⁴. *Hyptis Suaveolens* essential oil showed anti-fungal activity on some potentially pathogenic Aspergilli (*A. flavus*, *A. parasiticus*, *A. ochraceus*, *A. fumigatus* and *A. niger*) and authenticate its use as antifungal agent and its possible use as a therapeutic alternative for the treatment of infections caused by *Aspergillus* species²⁵.



The leaf extracted essential oil of *Hyptis suaveolens* has displayed dose-dependent mosquito-killing activity to *Cx. Quinquefasciatus* with LC₅₀ and LC₉₀ values of 6 and 21 ppm, respectively²⁶. This emphasises that *Hyptis suaveolens* is a possible attractive, safe, and environmental friendly replacement for chemical larvicides against *Cx. Quinquefasciatus*. The study also implied its antioxidant content and biological role (Aguete *et al.*, 2023). According to Adjou *et al.*,²⁷ extract from *Hyptis suaveolens* has a higher repellent capacity than the product of *Ocimum canum* against *Tenebroides mauritanicus* (L.) in the post-harvest application.

The active compounds in these oils can help alleviate inflammation, making them valuable in addressing inflammatory conditions such as arthritis, respiratory ailments, and skin disorders. Respiratory health benefits are another prominent aspect of essential oils. Inhalation of these oils can help promote clear airways, relieve congestion, and ease symptoms of respiratory conditions like coughs, colds, and sinusitis. They are often utilized in inhalation therapies and chest rubs. They can be used topically or in massage oils to alleviate muscle and joint pain. Furthermore, these oils have shown potential in

supporting wound healing. Their antimicrobial activity helps prevent infection, while their anti-inflammatory and analgesic properties reduce inflammation and pain associated with wounds²⁸.

GS-MS analysis of essential oil from *H. suaveolens*:

Findings from previous studies on GC-MS analyses of the vast array of plant extracts revealed that most of the herbal extracts with medicinal attributes contained some of the phytochemicals²⁹.

GC-MS analysis of the essential oil extract of *H. suaveolens* identified 19 bioactive compounds (Table 3 & Fig. 5). The identification of compounds is based on the peak area, molecular weight, and molecular formula.

The major constituents identified in the extract were trans-Caryophyllen, eucalyptol(1,8-cineole), Z-2-[1-(2,5-Dimethyl-3-furyl)-2-methylpropylidene]-3-isopropylidene succinic anhydride, α-Terpinolene, Bicycloelemen and 5,10-rimene, while all the other compounds were identified at low levels.

The terpenes, found in essential oils of different plants, are micro-constituents most commonly used as flavour additives in food, toiletries, and perfumes³⁰.

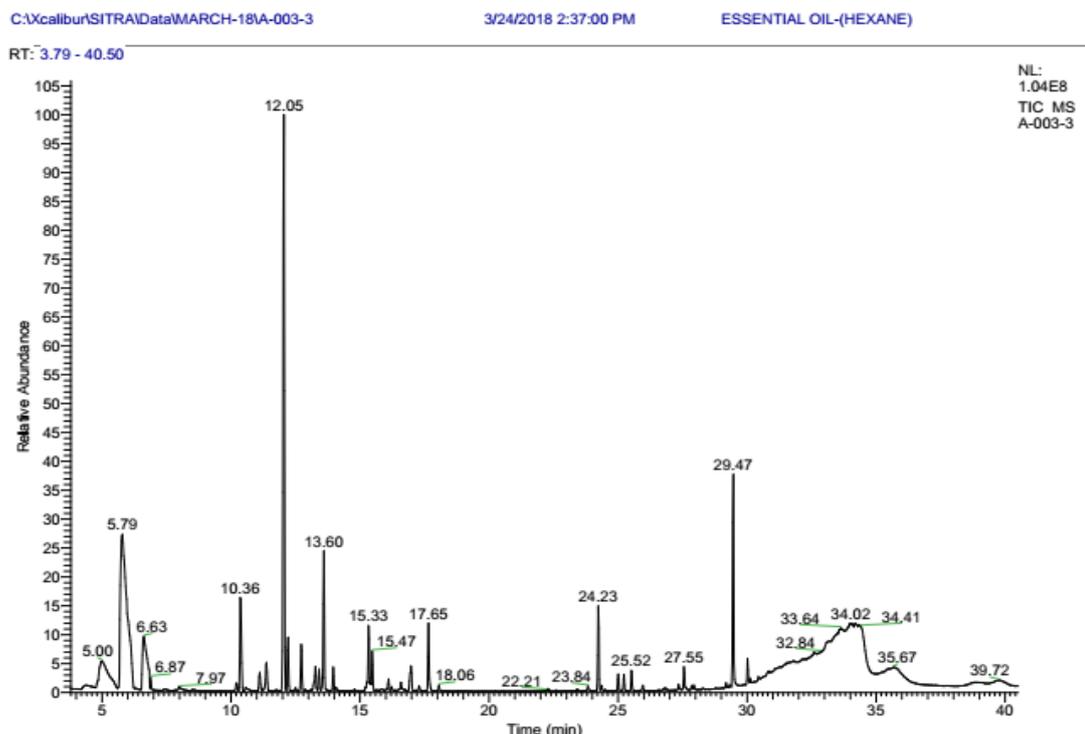


Figure 5: GC-MS analysis of the essential oil extract of *Hyptis suaveolens*

Table 3: GC-MS analysis of the essential oil extract of *Hyptis suaveolens*

S. No	Compound Name	Probability	Molecular Formula	Molecular Weight	Area %
1	Eucalyptol	53.98	C ₁₀ H ₁₈ O	154	15.99
2	α-Terpinolene	33.47	C ₁₀ H ₁₆	136	6.08
3	Bicycloelemen	41.85	C ₁₅ H ₂₄	204	4.44
4	α-Copaene	21.18	C ₁₅ H ₂₄	204	0.75
5	α-Elemene	20.20	C ₁₅ H ₂₄	204	1.39
6	Trans-Caryophyllen	32.70	C ₁₅ H ₂₄	204	23.22
7	α-Bergamotene (CAS)	40.70	C ₁₅ H ₂₄	204	0.42
8	α-Humulene (CAS)	57.78	C ₁₅ H ₂₄	204	1.89
9	Germacrene-D	26.27	C ₁₅ H ₂₄	204	1.12
10	Cubedol	30.57	C ₁₅ H ₂₆ O	222	0.89
11	(-)-Spathulenol (CAS)	39.87	C ₁₅ H ₂₄ O	220	3.77
12	Tricyclo [5.2.2.0(1,6)] undecan-3-ol	15.61	C ₁₅ H ₂₄ O	220	0.43
13	Veridiflorol	17.46	C ₁₅ H ₂₆ O	222	1.41
14	Bergamotol, Z-à-trans	64.95	C ₁₅ H ₂₄ O	220	2.46
15	5,10 -rimuene	15.53	C ₂₀ H ₃₂	272	2.96
16	Phenanthrene	77.45	C ₂₀ H ₃₀	270	0.54
17	(Z)-2-[1-(2,5-Dimethyl-3-furyl)-2-methylpropylidene]-3-isopropylidene succinic anhydride	14.58	C ₁₇ H ₂₀ O ₄	288	7.67
18	4-Epidehydro Abietlol	50.07	C ₂₀ H ₃₀ O	286	0.89
19	9-Octadecenoic acid (Z)-, 9-hexadecenyl ester, (Z)- (CAS)	28.61	C ₃₄ H ₆₄ O ₂	504	0.36

Trans-Caryophyllene plays a significant role in the essential oil of several plant species. It is a member of the sesquiterpenes chemical class. Numerous pharmacological effects, including analgesic activity³¹ and antimicrobial properties³², have been reported for trans-Caryophyllene. It triggers the endo cannabinoid system. Additionally, trans-Caryophyllene has a well-established anti-inflammatory effect^{33,34}. Trans-Caryophyllene also works on intestinal smooth muscle, preventing the excitation-contraction coupling through pharmacomechanical means. Because of these reactions, it can be regarded as a possible anti-spasmodic agent in tracheal smooth muscle^{35,28}.

Eucalyptol 1,8-cineole is found in many essential oils. It is the main ingredient of both eucalyptus (70%) and rosemary oils, whose concentration can exceed 45%. It is reported that 1,8-cineol (eucalyptol), eucalyptus oil's major monoterpene, suppressed arachidonic acid metabolism and cytokine production in human monocytes and has anti-inflammatory activity. It exhibits various biological properties,

including anti-inflammatory, antioxidant, antimicrobial, bronchodilatory, analgesic, and pro-apoptotic effects³⁶.

Z-2-[1-(2,5-Dimethyl-3-furyl)-2-methylpropylidene]-3-isopropylidene succinic anhydride is known for its photochromic effect (light-induced reversible change in color) due to its reversible photo-switching and well-separated absorption bands. Typical applications of this compound include optical data storage, sunglasses, and bright windows. It is also used in security inks, cosmetics, and biological systems. Organic usage of photochromic compounds in plastic ophthalmic lenses makes it more comfortable to wear. It is now competing with silver salt glasses and a shorter lifetime due to its organic nature³⁷.

α-Terpinolene is a monoterpene found in the essential oil of many aromatic plant species. The pharmacological analysis of this compound reveals that it displays a wide range of biological effects like antioxidant, larvicidal, and insecticidal activity³⁸. It also displayed anti-proliferative activity against brain tumour cells³⁹.



Antimicrobial, anti-inflammatory, and anticancer properties of Bicycloelemene were studied, and the results make this compound a special molecule for the development of new therapeutic agents (<https://www.ncbi.nlm.nih.gov/>)⁴⁰. Additionally, its antimicrobial properties were exploited in the development of new antibiotics.

Spathulenol, isolated from *Aristolochia yunnanensis* was reported for its antioxidant, anti-inflammatory, antiproliferative, and antimycobacterial activities. It shows high antioxidant activity with an IC₅₀ of 85.60 µg/mL in the DPPH system ⁴¹.

Bergamotol, specifically the Z-alpha-trans isomer, exhibits a range of biological activities, including antimicrobial, antioxidant, and potentially insecticidal properties. It is a component of bergamotenes, sesquiterpenes found in various plants, insects, and fungi. Some research suggests that bergamotenes, including Z-alpha-trans-bergamotol, can act as pheromones for certain insects ⁴².

Rimuene, a sesquiterpene compound, exhibits various biological activities, including antiasthmatic, antibacterial, antifungal, anti-inflammatory, antioxidant, and antineoplastic effects. It is a primary compound found in the leaves and stem bark extracts of *Agathis borneensis* ⁴⁰.

CONCLUSION

Extraction using the Clevenger apparatus was found to be one of the promising techniques for the extraction of Essential Oil from plants, as this process can preserve the original qualities of the plant. The present study revealed that the essential oil extracted from *Hyptis suaveolens* exhibits antioxidant activity. The chemical components identified using Gas Chromatography-Mass Spectrometry (GC-MS) were found to have diverse biological activity due to the possession of abundant phytochemicals. Isolation or chemical synthesis of these compounds finds its applications in food, cosmetic, and pharmaceutical industries since they are safer, cheaper, and eco-friendly. Further, the studies can be extended to exploit other biological activities and establish their safety for using *H.suaveolens* oil in food and other industries.

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Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Conflict of interest

The authors declare that there are no conflicts of interest in the publication of this content

Consent for publication

All the authors agreed to publish the content.

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