



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

© Agronomy

www.agronomyjournals.com

2024; 7(7): 192-197

Received: 10-04-2024

Accepted: 15-05-2024

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A comprehensive exploration of aromatic crops and their essential oils: Applications and uses

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i7c.1017>

Abstract

Aromatic plants have been used as folk medicine and food preservatives since ancient times. The most famous plants used to extract aromatic oils, such as citronella, lemongrass, geranium, rose, jasmine, wormwood, rosemary and basil, are in Southeast Asia and the Mediterranean region. Aromatic herbs are particularly beneficial to human culture because they are cheaper and easier to use, unique, natural, sustainable, and generally considered non-toxic. Therefore, aromatic plants play an important role in human health. Increasing interest in aromatic plants brings new income. They contain many bioactive compounds, especially polyphenols, which have been shown to have antibacterial, antioxidant, antiparasitic, antiprotozoal, antifungal and anti-inflammatory properties. Today, the demand for these plants and their derivatives, which are considered natural, environmentally friendly and safe products, is increasing. The aim of this review is to provide an overview of the literature on the *in vivo* and *in vitro* use of aromatic plants.

Keywords: Aromatic plants, antibacterial, essential oils, perfumery, aromatherapy

Introduction

Due to some factors affecting the development of agriculture in the current situation such as climate change, crop failure, irregular rainfall and natural disasters. Aromatic products are highly profitable and commercial products that lead to the expansion of the economy in the country. Cash crop production is increasing and India is not making profits globally. Aromatic plants contain volatile compounds in the form of oleoresins, gum secretions, balsams and essential oils in one or more parts of the plant (such as leaves, stems, roots, bark, wood, flowers and fruits) (Joy *et al.* 2001a b) ^[14] 2014). Many combinations create unique scents. All aromatic plants have a unique chemical composition and content that varies from plant species to plant species and plant age (Patel, 2016) ^[21]. This essential oil is stored in glandular trichomes, secretory ducts, cavities, and sometimes in the oil plant (Mathe, 2015) ^[19]. Aromatic plants are frequently used in the aromatherapy, perfume and cosmetic industries because they have a strong scent from essential oils. This difference, resulting from the different agro-climatic conditions of our country, provides sufficient conditions for growing and harvesting aromatic plants in one place or another. Therefore, in order to produce good spice/medicinal products regarding raw materials, proper use of agricultural equipment, planting, harvesting and management etc. precautions need to be taken. Middle East, B.C. It has been known since 5000 BC for its antiseptic and antibacterial properties and for improving the aroma and flavor of food. Today, plant use continues unabated, and according to the World Health Organization (WHO), approximately 80% of the world's population, especially in developing countries, still relies on medicines made from plants for treatment. (Efterpi *et al.*, 2012) ^[9] Many aromatic plants have been used as medicine for a long time. Many specific metabolites have been isolated and shown to have therapeutic activities such as anti-diabetic activity, antioxidant activity, anti-inflammatory activity, anti-inflammatory activity, anti-inflammatory activity, wound healing and hypolipidemic effects. Traditional methods, including the making of essential oils, are important and are still used in many parts of the world. Hydrodistillation, water and steam distillation, steam distillation, co-boiling, maceration and machine drying are the most common and widespread methods.

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In cases where oil distillation is low, the maceration method can be used (Abdullah *et al.*, 2020) ^[1]. The distillation process works well with wheat flour, flowers and flowers; Solvent extraction, on the other hand, works well on expensive, delicate and thermally unstable materials such as jasmine, tuberose and hyacinth. Hydrodistillation is the most popular method of producing lemon and citronella oil from plant material.

Conventional uses of aromatic plants

1) Palmarosa

Cymbopogon martini is an important family of herbs known for their high oil content. Essential oils (unchanged oils, essential oils, aetherolea) are hydrophobic liquids containing the unpleasant aroma of plants. Plants produce many secondary metabolites or specific phytochemicals; Among these, essential oils are an important group. (Sharma *et al.*, 2013) ^[25]. Citronella essential oil and its products are known for their antibacterial (De Billerbeck *et al.*, 2001) ^[8], antihelminthic, antiparasitic (George *et al.*, 2010) ^[12], anti-inflammatory (Francisco *et al.*, 2011) ^[11], anticonvulsant and antioxidant properties. Many publications preceded the reporting of citral (combination of geranial and neral), geraniol, citronellol, citronellal, linalool, 1,8-cineole, limonene, aromatic phyllol, β -caryophyllene, methylheptenone, geranyl acetate, and geranyl formate.

Pharmacological activities

- *C. martini* (palmarosa) essential oil is used as fumigation to control beetles like *Callosobruchus chinensis* and *Tribolium castaneum*, which grow in stored grain. (Kumar *et al.*, 2007) ^[17].
- Palmarosa showed significant beneficial effects on several central nervous system pathologies, mainly neuralgia, epileptic and anorexia.
- The main component of nicotine is an acyclic monoterpene compound found abundantly in many plants. It may represent a new class of drugs against pancreatic cancer (Burke *et al.*, 1997) ^[6] and colon cancer (Carnesecchi *et al.*, 2001) ^[7] and has many biological properties, including Antibiotics, Antibiotics, and Antibiotics. (Patnaik *et al.*, 1995) ^[22]; (Nirmal *et al.*, 2007) ^[20].

Citronella

Cymbopogon winterianus is an important member of the Gramineae family. Anti-inflammatory agents citronellal, geraniol and citronellol are the main components. As a dietary supplement, the US Food and Drug Administration has determined that it meets the criteria for the GRAS designation "generally recognized as safe" (Bond *et al.*, 2013) ^[4]. Citronella has been used as a mosquito repellent in ancient and modern medicine for many years. Commercial mosquito repellents contain chemicals that are harmful to human health.

Pharmacological Activity

- Citronella is a natural pesticide in amounts between 5 and 10% and is currently one of the most popular options on the market.
- Citronella oil is effective as an antiseptic, antibacterial and egg-laying repellent for many insects.
- Citronella oil is an antibacterial and antibacterial agent, as well as an anti-mosquito (*Aedes aegypti*) and insect (*Spodoptera Frugiperda*) agent.
- Volatile essential oil is extracted from its leaves using steam extraction technology.
- The oil is used in traditional medicine as an antiseptic,

nematicide, antiseptic, antiseptic, antiseptic, diuretic, antispasmodic and aromatic tea. For mosquito bites, including *Aedes aegypti*, citronella oil has been shown to be most effective, providing antibacterial effects for 2 hours (Trongtokit *et al.*, 2005) ^[30].

Lemongrass

Cymbopogon flexuosus belongs to the Poaceae family and is a fragrant herb native to southern India and Sri Lanka and is currently grown in America and Asia. Essential oil is obtained from freshly cut and slowly dried leaves that are used medicinally. The strong lemon flavor is the main feature of this plant and this is due to the high citral content in its oil. The aromatic oil makes it useful in soaps, hand sanitizers and more. Depending on its quality, citral has applications in the flavor and food industry. It is also the starting material for the production of ionone (which produces vitamin A).

Pharmacological Activity:

- The lemon prefix is attributed to the lemon odor resulting from the presence of citral and cyclic monoterpenes.
- Lemongrass contains botanical components such as tannins, flavonoids, alkaloids and various essential oils. Evidence of the antibacterial, antifungal, antiviral, anti-inflammatory, anti-obesity, anti-nociceptive, anxiolytic and anti-inflammatory (pain-relieving) properties of lemongrass tea has been clearly shown to support the chief pharmacist.
- The compounds found in lemongrass citric acid are mainly terpenes, alcohols, ketones, aldehydes and esters.
- Some of the most popular herbal essential oils include citral, nerol, geraniol, citronellal, terpinolene, geranyl acetate, myrcene, and terpineol methylheptenone. (Sehajpal *et al.*, 2023) ^[24].

Basil

Ocimum sanctum L. is a plant belonging to the Lamiaceae family. The essential oil in basil is obtained from the seeds, stems, flowers and leaves. The most important oil is found in the leaves. The essential oil of the leaves contains eugenol, ursolic acid, carvacrol, linalool, limassol, caryophyllene and methylpiperol. *In vitro* studies of these phytochemicals indicate their wide use as anticancer, antifungal, antimicrobial, antioxidant, and anti-inflammatory. The essential oil obtained from different basil species may contain alcohol (linalool), oxides (1,8-cineole), phenols (eugenol, methyleugenol, methylisoeugenol, thymol), esters (methyl cinnamate), aldehydes (citral), and camphor. Chemicals such as 1,8-cineole, methyl cinnamate, methylpiperol, and linalool are responsible for the unique aroma of the basil plant. (Sienkiewicz *et al.*, 2013) ^[28].

Pharmacological activity

- Basil oil has been shown to be a powerful antioxidant.
- Immuno-modulatory activity, anti-anxiety, anti-diabetic, antipyretic activity, anti-arthritic activity, antioxidant activity, as a preservative. (Klimankova *et al.*, 2008) ^[16].

Rosemary

Rosmarinus officinalis L. belongs to the Lamiaceae family. It is used in folk medicine to treat many diseases such as headache, cold, abdominal pain, epilepsy, rheumatic pain, spasms, nervous agitation, improving memory, hysteria, melancholy, physical and mental fatigue. It is used to flavor foods, beverages and cosmetics.

Pharmacological activities

- Its therapeutic properties include reducing bronchial asthma, reducing muscle stiffness, treating peptic ulcers and being an anti-cancer agent.
- Rosemary essential oil contains mainly 1,8-cineole (46.4%), camphor (11.4%) and α -pinene (11.0%).
- The biological activity of rosemary extract has properties such as anti-inflammatory, anti-diabetic, hepatoprotective and antibacterial activity. These activities are related to the phenolic compound composition (mainly caffeic acid, rosmarinic acid and carnosic acid) (Sienkiewicz *et al.*, 2013) ^[28].

Peppermint

Peppermint oil is derived from the perennial herbaceous plants *Mentha Piperita* L. and *M. arvensis* var. It is obtained from its leaves. *Piperascens* is a member of the Lamiaceae family. India is the world's largest producer and exporter of peppermint oil. Peppermint oil and its products and derivatives are used in the food, pharmaceutical, perfume and condiment industries. Its main component is lozenges, toothpaste, analgesic cream, cold paste, Dabur Pudra Hara etc. Menthol is used in its production. The oil is used to treat some stomach disorders such as indigestion, gas problems, and excessive acidity.

Pharmacological activities

- Various chemical constituents of mentha oil are limonene (1.0-5.0%), cineole (3.5-14.0%), menthone (14.0-32.0%), menthofuran (1.0 -9.0%), isomenthone (1.5-10.0%), menthyl acetate (2.8-10.0%), isopulegol (max. 0.2%), menthol (30.0-55.0%), pulegone (max. 4.0%) and carvone (max. 1.0%).
- It is used in the stomach and intestines, has antibacterial and anti-inflammatory properties, prevents nausea after surgery.
- Also used as herpes simplex inhibitor, larvicide and mosquito repellent.

Geranium

Geranium belongs to the Pelargonium family. It is known for its scents made of precious substances. It has a very strong, beautiful rose-coloured scent with a mint flavor, so it is used as a substitute for expensive rose oil and is also called "poor man's rose oil". Rose-scented geranium essential oil is widely used as an ingredient in food, cosmetics, perfumes and pharmaceutical products. Rose-scented geranium essential oil is also known for its benefits in many health-related treatments, such as its anti-inflammatory and antioxidant properties, aromatherapy and antibacterial properties. Lott and Verma (2023) ^[18].

Pharmacological activities

- Geranium essential oil contains more than 200 organic compounds, which are mostly low molecular weight plant products such as terpenes and amphetamines.
- Terpenes are the main components of essential oils. Essential oil is the main component of rose-scented geranium, and its content in geranium is between 0.06% and 0.16%. Essential oil, 37.5% citronellol, 6% geraniol, 3.7% caryophyllene oxide, 3.1% menthone, 3% linalool, 2.7% beta-bourbonene, 2.1% isomenthone, 2.0% geranium ester. (Sharopovet *et al.* 2014) ^[26].

Davana

Artemisia pallens is widely used in Indian folk medicine to treat diabetes and cancer. It is grown for its leaves and flowers.

Artemisia oil is used in the production of perfume and fragrance. *Artemisia* oil soothes rough, dry, cracked skin, skin infections and cuts. *Artemisia* is the favorite food of many butterfly larvae. *Artemisia* is traditionally used for diabetes, wound healing, anti-inflammatory, anthelmintics, antipyretic and wound healing. It is used as an aphrodisiac and mood enhancer. It is an excellent protector. This oil also contains mild antibacterial properties. It is effective in reducing the risk of chronic diseases, heart diseases and cancer.

Pharmacological properties

- *Artemisia* annually produces saponin alkaloids, sterol glycosides, davidone, isodalkanone, linalool, dehydro- α -linalool, terpinen-4-ol, davidin, artemicinone, epipallitolak, eucalyptolac. (Shreyas *et al.*, 2018) ^[27].

Rose

Rosa sp., popularly known as Rose, belongs to the Rosaceae family. Rose oil is an essential oil obtained from the flowers of rose plants, especially *Rosa damascena* and *Rosa centifolia*. The most important components of rose oil are terpenes, glycosides, flavonoids and anthocyanins. Rose oil is said to have anti-inflammatory, anti-inflammatory, and wound-healing properties and can be used to relieve headaches, hemorrhoids, gastroenteritis, and muscle pain. It is well known that the scent of essential oils can be used to treat ailments through aromatherapy.

Pharmacological activities

- Some studies have proven that it acts as a hypnotic, anticonvulsant, antidepressant, antianxiety, analgesic, and relieves central nervous system (CNS) morphine withdrawal symptoms.
- Rose oil has broad-spectrum antibacterial and antifungal properties against bacteria such as *Bacillus cereus*, *Pseudomonas aeruginosa*, *Pseudomonas fluorescens*, *Penicillium notatum*, *Aspergillus niger* and *Candida albicans*.
- The compounds that make up more than 95% of the total oil are β -citronellol (14.5-47.5%), nonadecane (10.5-40.5%), geraniol (5.5-18%) and the main components are nerolidol and Kev Analysis is Kaempferol Rose. Absolute, phenyl ethanol (78.38%), citrol (9.91%), nonadecane (4.35%) and geraniol (3.71%), ethanol (0.00-13.43%) and panic of hexadecane alkanes shows its main components. In another study, the components of rose were phenylethyl alcohol (72.73–73.80%), citrol (10.62–11.26%), nerolidol (2.42–2.47%) and geranal (5.58–5%). 65). The hydrosol was also found to contain four components: the main ingredient is geraniol (30.74%), followed by citronellol (29.44%), phenylethanol (23.74%) and nerolidol (16.12%). (Almasirad *et al.*, 2007) ^[2].
- It has good anti-neuropharmacological effects, hypnotic effects, analgesic effects, anti-neuritis atrophy effects and protective effects.

Jasmine

Jasminum sp. commonly known as jasmine, jasmine belongs to the Oleaceae family. Essential oils can be extracted from oil "vesicles" in flowers, leaves, stems, roots, seeds, wood, and bark. It is well known that the scent of essential oils can be used to treat ailments through aromatherapy, inhalation or massage therapy. Jasmine oil helps treat major depression and relaxes the nervous system, creating feelings of confidence, hope and

enthusiasm, while rejuvenating and restoring energy and improving memory.

Pharmacological activities

- The main compounds of jasmine oil are benzyl acetate, β -linalool and benzyl propionate.
- Reported properties of the essential oil are carminative,

aromatic, antispasmodic, antidepressant, antiseptic, astringent and stimulant. Data on the effects of jasmine scent on research participants support the human hypothesis.

Aromatic plant species in India

S. No.	Common name	Botanical name	Family	Uses
1.	Palmarosa	<i>Cymbopogon martini</i>	Poaceae	Perfumery, Soaps and flavouring tobacco.
2.	Citronella	<i>Cymbopogon winterianus</i>	Poaceae	Perfumery, cosmetic and flavouring industries.
3.	Lemongrass	<i>Cymbopogon flexuosus</i>	Poaceae	Flavouring agent, perfumery, insect repellent hair oils, medicines and headaches.
4.	Basil	<i>Ocimum sanctum</i>	Lamiaceae	Dental creams, flavouring agent, perfumery, antibacterial, salads, cough and insecticidal preproperties.
5.	Rosemary	<i>Rosmarinus officinalis</i> L.	Lamiaceae	Antimicrobial, flavouring, perfumery and fixative property.
6.	Mint	<i>Mentha arvensis</i>	Lamiaceae	Flavouring agent, toothpaste, mouth wash, cough drops, aftershave lotions.
7.	Davana	<i>Artemisia pallens</i>	Asteraceae	Religious offering, garlands, bouquets, perfumes & cosmetics.
8.	Geranium	<i>Pelargonium graveolens</i>	Geraniaceae	Perfumes, soaps and cosmetics.
9.	Rose	<i>Rosa spp.</i>	Rosaceae	Perfumery, Rose oil, Rose water, attar, gulkand and flavouring agent.
10.	Jasmine	<i>Jasminum spp.</i>	Oleaceae	Hair adornments, religious offering, hair oils, attar, jasmine absolute, perfumes and cosmetics

(Farooqi A.A and Sreeramu B. S, 2004) ^[10]

3. Essential Oil and Trade

The Symbiosis Essential oils are characterized as capricious, odorous, hydrophobic and extremely concentrated compounds derived from many of the plant parts like roots, leaves, twigs, buds, flowers, wood, bark, fruit and seeds, and preserved in canals, cavities, secretive cells, epidermal cells and glandular trichomes (Bakkali *et al.*, 2008) ^[4]. Terpenes and aromatic compounds are two chemical components that come through two different biosynthetic alleyways. Terpenes and terpenoids make up the majority of the group, while the remainders are aromatic and aliphatic elements, all of which are distinguished by a low molecular weight.

Exports

In 2021, India exported \$817M in essential oils, making it the 2nd largest exporter of essential oils in the world. At the same year, essential oils were the 90th most exported product in India. The main destination of essential oil exports from India are: United States (\$224M), China (\$127M), France (\$53.8M), Germany (\$42.6M), and United Kingdom (\$31.4M). The fastest growing export markets for essential oils of India between 2020 and 2021 were China (\$29.7M), United States (\$19.8M), and Mexico (\$15.1M) (Anonymous, 2021) ^[3].

Imports

In 2021, India imported \$192M in essential oils, becoming the 7th largest importer of Essential Oils in the world. At the same year, essential oils were the 288th most imported product in India. India imports essential oils primarily from: Indonesia (\$35.2M), Brazil (\$17.9M), United States (\$15.9M), China (\$15.7M), and Thailand (\$14.5M). The fastest growing import markets in essential oils for India between 2020 and 2021 were Thailand (\$14.4M), Hong Kong (\$6.74M), and Australia (\$4.02M) (Anonymous, 2021) ^[3].

Future prospects and constraints

Prospects

1. Despite the developments in chemical technology and the emergence of cheap, synthetic and complex molecules from simple molecules through certain reactions, aromatic plants

and their derivatives will also play an important role in aromatherapy. For example, vitamin A from plants can be in the form of stearic acid, and chemical synthesis creates a mixture of isomers that can be difficult to separate. As a result, synthetic products may be toxic or have different medical effects than natural products.

2. The demand for herbal medicines and plants indigenous to India has increased significantly in western countries. Domestic demand for raw materials used in spices, medicines and bio-pesticides has also increased.
3. India is a source of cheap and skilled labour and can easily absorb and implement technological changes. Also, this crop has many advantages like drought resistance and ability to grow on marginal lands. They have good resistance to cattle damage and hence can be effectively grown in areas where stray cattle, wild animals or thieves are a problem. For this reason, aromatic plants are more valuable than many other products.
4. Since these are new crops, there is a lot of scope to increase their productivity and flexibility to achieve greater benefits. They are suitable to include various types of planting, such as intercropping, mixed planting and multi-layer planting.

Constraints

1. Although India is one of the world's largest producers and exporters of medicinal and aromatic plants, the growth of this crop is unsatisfactory compared to business prospects.
2. Despite the strong support provided by the Government of India through organizations such as the Center for Medicinal and Aromatic Plants (CIMAP), Regional Research Laboratories (RRL) in Jammu, Bhubaneswar and Jorhat; DMAPR, National Botanical Research Institute, Lucknow, Forest Research Institute etc. Educational organizations and inspections are very few.
3. Another important limitation is the sale of products grown for good reasons. The lack of testing facilities in sales and marketing, together with unfair commercial practices, leads to large variations in prices, often falling into questionable and non-existent certainties.
4. Growing some aromatic herbs is considered a frustrating

task, especially due to their incredible cost. Lemongrass, for example, is sold for as little as Rs 20 per plant, making it a bad business. Business users need to step forward and ensure that the grown product is homogeneous compared to the natural product, which can be very different.

5. Although most of these are cash crops, the machinery and working methods used for commercial oil extraction are not suitable for large-scale commercial cultivation.

Conclusion

Aromatic plants, their extracts and essential oils contain many active bioactive compounds that can be used in food, feed, medicine and cosmetics. Herbs are available in all pharmacies and grocery stores. These herbs and Indian herbs are also rich in beneficial properties, including antioxidants and ingredients that can be used in foods, and aromatic herbs such as lemongrass, palmarosa, citronella, rose, jasmine and rosemary oils are also widely used in perfumes. The growth of the cosmetics and cosmetics industry has created career opportunities for many people. New methods using collaborative research and modern technology, together with established health models, will lead to significant health benefits in the future, especially for people who do not have access to more expensive Western medicine. Biopharmaceutical companies need access to a broader market and research on Ayurvedic medicine so that consumers can use it more frequently. All companies in India, with the support of state and central governments, must establish world-class quality management and R&D facilities to support and assist importers to ensure quality products are exported from India. Protection of all types of work must be learned. This creates a huge challenge for conservationists, policymakers, scientists, businesses and farmers to creatively manage some of nature's most important medicinal and aromatic plants.

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