



Role of Essential Oils of Spices and Herbs and Their Applications: A Review

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Authors' contributions

This work was carried out in collaboration between all authors. Authors TP and S. Shenbagavalli designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors KS, S. Sundraiah and CR managed the analyses of the study. Author SG and S. Sangeetha managed the literature searches. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Essential oils (EOs) are pure, fragrant, volatile liquids that are obtained from particular plants. Almost all plant organs, particularly the flowers, buds, leaves, seeds, stems, and fruits, produce essential oils [16]. Terpenes, phenolic chemicals, and alcohol make up the complex mixture of secondary metabolites that make up EOs [8]. EOs possess a wide range of biological activities including antioxidant, antimicrobial and anti-inflammatory ones. Antioxidant, antibacterial, and anti-inflammatory biological actions are only a few of the many biological properties that EOs have. EOs are utilised in sanitary products (fragrances for home cleaning products), cosmetics (perfumes and makeup products), agriculture (bio-pesticide and repellent), and aromatherapy as natural cures. The earliest, simplest, and most widely utilised techniques for extracting Eos include steam distillation and hydrodistillation [17].

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The antibacterial and antioxidant qualities of thymus, cinnamon and oregano essential oils intended for use in the meat sector. Chinese cinnamon and turmeric essential oils have been employed as additives in biodegradable coatings and films [21]. Some plants and EO, including clove, thyme, rosemary, oregano, cinnamon, and pimento, have been found to have strong inhibitory effects on a variety of bacterial pathogens. The essential oils of a number of plant species, including thymus, mentha, artemisia, limnophila, salvia, and rosmarinus, are effective against a variety of arthropod species, including the silverleaf whitefly, aphids, bihar hairy caterpillars, cabbage loopers, diamond back moths, and leaf rollers, which are major pests of horticultural and stored grain crops [45,46]. Patchouli essential oil has also been discovered to be a highly effective substitute for shielding skin from UV radiation. EOs used in shampoo formulations with a pH range of 5.5 to 6.5, such as lavender (*Lavandula angustifolia*) and geranium (*Pelargonium graveolens*), may have synergistic effects.

Keywords: Essential oils; fragrant; food preservation; lemongrass; menthe; Artemisia; limnophila; salvia.

1. INTRODUCTION

Essential oils (EOs) are colourless liquids that are mostly made up of the aromatic and volatile substances that are found in all sections of plants, including the seeds, flowers, peel, stem, bark, and whole plants [32]. EOs are made of hydrocarbons and when it comes to terpenes [52,53], such as monoterpenes, sesquiterpenes, and diterpenes [30], or oxygenated compounds, which are primarily phenols, alcohols, aldehydes, ketones, esters, and oxides [7,8]. Essential oils are volatile, typically liquid, and colourless at room temperature. They are poorly soluble in water but highly soluble in alcohol, organic solvents, and fixed oils. They occasionally have a distinctive taste as well as a variable refractive index and a very high optical activity 2014 [3,4,12]. The specific aromatic and chemical properties of EOs perform numerous crucial tasks for plants in nature, including

- Attracting beneficial insects and pollinators,
- Shielding the plants from some environmental stress (heat,cold, etc.) and
- Protecting plants from pests and/or microorganisms [11,16].

2. VARIOUS USAGES OF ESSENTIAL OILS

2.1 Flavors

In the food industry, plant-based aroma compounds that make up essential oils play a significant role as natural flavourings and preservatives [38]. To add desired flavour (taste and/or fragrance), essential oils and the

ingredients that make them up are utilised in meals and beverages [9]. The essential oils from a variety of aromatic plants, including Geranium (*Pelargonium graveolens*), Lavender (*Lavandula officinalis*), Roman chamomile (*Anthemis nobilis*), and Rosemary (*Rosmarinus officinalis*), give food products a pleasant aroma in addition to flavour [29].

2.2 Preservatives

Typically, the food products can be preserved using sodium nitrite, potassium nitrite, sodium nitrate, and potassium nitrate. Such chemical substances may have detrimental impacts on human health [5,6]. Eos can increase the shelf life of the food product by preventing the growth of a number of dangerous bacteria and spoilage microorganisms that synthetic substances may occasionally be unable to get rid of [56]. Natural agents, such as plant extracts and essential oils, can be used to preserve food in a variety of ways, including:

- **Safety-** slowing/stopping the growth of food poisoning micro-organisms
- **Health-** slowing the deterioration of nutrients
- **Quality-** Maintaining texture, taste and aroma
- **Shelf life-** reducing waste and increasing convenience [23]

2.3 Medicinal Uses

The United States Food and Drug Administration (FDA) stated in 2005 [14,15] that EO can be used safely and that its constituent parts can be added to antimicrobial medications to prevent the

emergence of resistance to antibacterial, antifungal, and antiviral medications.

2.4 Active Food Packaging

Cardboard and paper have traditionally been used as packing materials. Due to their water vapour permeability, it is handy and required to add a layer of some material that makes them resistant to the presence of water, vapours, and gases. EOs are a desirable substitute for making such films [10].

2.5 Agriculture

In contrast to synthetic pesticides, which pose more hazards to the environment and human health, EO are bio-sourced products that are thought to be more environmentally friendly and alternative options [48]. The mechanisms of secondary metabolites' antifungal activity include inhibiting the growth of fungal cell walls, rupturing cell membranes, preventing mitochondrial electron transport, preventing cell division, preventing protein synthesis, and inhibiting efflux [33,34]. Although synthetic pesticides have been used to control insects for many years, they have caused several health issues [25], and their residues have been shown to seriously harm fish, birds, and beneficial insects [44].

2.6 Cosmetics

Essential oils are commonly used in contemporary skincare products due to their complex active chemical makeup, potent fragrance, and all-natural marketing appeal [18]. They are also utilised to give the skin further advantages like anti-aging, anti-acne, skin whitening, and sun protection [54].

3. APPLICATIONS OF ESSENTIAL OILS IN DIFFERENT INDUSTRIES

More than 3000 different varieties of EOs have been found, but only 300 of them are important from an industrial perspective for uses in the food industry, frequently for the flavours and fragrances sector [7]. It should be noted that EOs' extreme volatility, transitory nature, and biodegradability contribute to their widespread acceptance by consumers [21].

3.1 Food Industry

Essential oils are often utilised in food items as antioxidants, but they are also employed in many

other ways, such as flavouring, fragancing, and as a significant component of active packaging. Lavender or bergamot essential oil, is used as a flavoring agent in chocolate and chocolate coating (candy melts) [43]. Essential oils of Chinese cinnamon, citrus, and turmeric have been employed as additives in coatings and biodegradable films for active food packaging. Depending on their composition and interactions with the polymer matrix, they can give the films and coatings antioxidant and antibacterial capabilities.

3.2 Baking Industry

The baking business (cakes, baked products, and sweets) uses peppermint and clove essential oils, which are both quite pungent and utilised as flavourings.

Table 1. Different types of plants and their flavouring agent

Plant Essential Oil	Flavouring Agent
Basil	Sauces and condiments
Lemongrass	Beverages and sweets
Eucalyptus	Beverages, sweets and icecream
Geranium	Sweets and chewing gum
Peppermint	Flavour liquors, icecream, chewing gum and chocolate
Green mint	Drinks, sweets and icecream

[27]

Vanilla essential oils are utilised in soft drinks as a flavouring agent. Stevia (*Stevia rebaudiana*), a plant whose leaves are used to sweeten beverages because they contain a variety of essential oils with a sweet flavour. Food and beverages are flavoured with EOs from a variety of plant species [23].

3.3 Food Packaging

The stability of volatile components is increased, protecting them from interacting with the food matrix, and the antimicrobial activity is increased. Essential oils can be encapsulated in polymers of edible and biodegradable coatings that provide a slow release to the food surface of packages, such as fruit, meat, and fish. A benzoic acid-chitosan nanogel was used to successfully encapsulate rosemary essential oil, and this nanogel was then added to the starch-carboxy methyl cellulose film [41].

3.4 Medicinal Industry

Some plants and EO, including clove, thyme, rosemary, oregano, cinnamon, and pimento, have been found to have strong inhibitory effects on a variety of bacterial pathogens, according to several studies [37,19]. Thymol, an antibacterial compound, is found in thyme essential oil [1].

3.5 Agriculture

Citral and lemongrass essential oil are effective against cowpea weevils, suggesting a potential alternative to conventional insecticides. Reduced lipid content, altered sexual behaviour, and changes in the overall activity of biotransformation enzymes are all brought on by lemongrass essential oil [7].

3.6 Cosmetics Industry

Among the market's rising demand for herbal cosmetics, essential oils are of great interest. The use of EO as active agents or enhancers in cosmetics has drawn significant attention [2].

Essential oils are essential ingredients in the beauty business since they not only give products nice fragrances but also work as preservatives and active ingredients while simultaneously providing the skin with a number of health benefits [50]. The cosmetic industry uses essential oils extensively as skin regenerators in products like safe tonics, lotions, creams, shower gels, and soaps made by specialised businesses like Dr. Beta-Pollena Aroma, Farmona Organique, Sanoflore, and Yves Rocher. Because essential oils can absorb the majority of UV rays (in the wavelength range of 290-400 nm), they can be included in the formulation of sunscreen to prevent photo-aging, sunburn, wrinkles, and other skin problems [36]. Peppermint oil enables the preparation of sunscreen formulations with an SPF value comparable to those corresponding to the non-volatile oil with the best performance [26].

Natural ingredients, botanical compounds, and 'free-from' claims (such as free of salts, sulphates, silicones, parabens, and other substances seen as hazardous) are what customers most want in the hair care sector, according to Cosmetic Innovation 2021. EOs typically have wonderful smells that make them suitable replacements for the offensive odours found in the majority of dandruff shampoos, providing a soft, natural scent [31]. EOs used in

shampoo formulations with a pH range of 5.5 to 6.5, such as lavender (*Lavandula angustifolia*) and geranium (*Pelargonium graveolens*), may have synergistic effects. The EO active elements can immediately enter the scalp, nourish deep hair follicles, supplement nutrients, stimulate hair follicle growth, moisturise hair roots, strengthen hair, and even efficiently remove undesirable metabolites that can otherwise damage hair [55].

3.7 Perfumery Industry

Synthetic fragrances are unsafe for human applications. chemicals found in man-made fragrances include phthalates, which are endocrine disruptors and known carcinogens such as benzene derivatives [13]. The global natural fragrances market is witnessing high growth due to increasing usage of natural fragrances such as essential oils over synthetic fragrances as a result of their associated numerous health benefits [24]. Top notes give the blend a freshness by being the most volatile and the first detectable odours that are detected. Top notes also fade first. They are the selling point of a perfume because they are in charge of customers' initial perceptions. They are light scents, lasting 5–10 min or remaining for a maximum of 30 min [51]. These include bergamot, juniper, cinnamon, and gardenia.

Middle notes are those essential oils that offer body to blends and have a tendency to be spicy or floral; their duration is also short and can last up to an hour. Ylang-ylang, geranium, lavender, and clove are a few of these. Base notes are the least volatile essential oils and persist the longest in a perfume, adding depth and staying power for up to many hours. Myrrh, vanilla, sandalwood, and frankincense are a few examples of essential oils that are employed as base notes [24].

3.8 Aromatherapy

Aromatherapy is the application of premium essential oils to the body through the skin or respiratory system [20]. This approach is particularly crucial for the treatment of conditions affecting the respiratory system, mouth and throat inflammations, mental disorders, immune system activation, and psychotherapy [49]. The lungs and nasal mucosa allow the oils to enter the body, where they go to the bloodstream where they exert systemic effects and have an impact on the patient's thinking [28]. Massage is

the fundamental direct aromatherapy technique. Antioxidant-rich essential oils help to promote lymphatic circulation and detoxify the body. To improve the results of lymphatic massage, utilise oils such as ginger, rosemary, clary sage, cypress, geranium, juniper, or sandal [35].

Aromatherapeutic baths are specialised techniques that make use of the healing abilities of essential oils. The medicinal compounds found in essential oils enter the bloodstream while bathing via the sweat and sebaceous glands as well as the airway [47]. Different systemic, cutaneous, neurological, or cardiovascular disorders are treated with aromatherapeutic baths, which are also used as muscle-relaxing or strengthening treatments [42]. The sauna, which combines air and skin aromatherapy, is another example of the usage of essential oils in spa and wellness facilities. Regular sauna use relaxes, toughens up the body, boosts immunity, and helps to maintain physical efficiency. Sauna creates the conditions (dilatation of superficial blood vessels due to high temperature, increased perspiration) facilitating the penetration of oils to the body [28]. Essential oils have comprehensive qualities that influence a person's physical, psychological, and spiritual well-being. As a result, they are a great treatment for ailments brought on by poor food, bad habits, exhaustion, and stress [40].

4. ADVANTAGES AND DISADVANTAGES

Due to EOs' comparatively healthy status—the majority of which are usually viewed as harmless, quickly biodegradable, ecologically benign, and non-phytotoxic interest in them is growing [22]. One of the main issues with manufacturing essential oils on a big scale is the relatively low yield per mass of raw materials, which appears to be the cause of the typically high prices the oils command on the global market [39]. Complex mixtures of chemicals, some of which are known allergens and skin sensitizers, should be disclosed on cosmetics labels, especially for consumers with sensitive, allergic-prone skin or pre-existing skin disorders who may choose to conduct patch tests prior to using products containing them [50].

5. CONCLUSION

The "Back to nature" movement has greatly increased the usage of botanical oils and extracts at the expense of man-made, synthetic versions, which are seen to be harmful to human

health. Essential oils are more in demand as a result of growing scientific evidence supporting their health advantages, which makes them more alluring to consumers. In light of this, the market for essential oils appears to have a bright future, with attractive opportunities in the cosmetic and fragrance industries [50].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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