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Essential Oils Have the Potential to Be Effective Therapeutic Agents in The Future

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Abstract

Objective: Medical treatments and preventions have made use of essential oils since the middle ages. Bactericidal, fungicidal, and antioxidant characteristics are among the various uses for essential oils in the fields of sanitation, pharmaceuticals, cosmetics, agriculture, and food. The volatile components of these plants are phenol-derived aromatics, aliphatic compounds, and terpenes and terpenoids.

Material and Methods: Our paper discusses some of the biochemical properties of essential oils, including their antimicrobial properties, which can be used instead of dangerous synthetic fungicidal and bactericidal products. Articles were related to searching keywords such as essential oils, agents, Medicinal plants. PubMed, Google Scholar and SID databases were used as search sources.

Results: Essential oils are used as antimicrobial, antiviral, anti-inflammatory, antioxidant and insecticidal compounds

Conclusion: In recent years, increasing interest has been shown in the possibility of using essential oils as antimicrobials and preservatives in various industries.

Introduction

The secondary metabolites of plants, termed volatile or ethereal oils, contain volatile organic molecules, called essential oils. Essential oils can contain upwards of 20-60 components with wide range of concentrations [1, 2]. In contrast other components are composed of monoterpenes, sesquiterpenes, and phenylpropanes, containing a diversity of organic groups [1-4]. Additionally, plants emit a distinctive aroma that can attract or repel insects, allowing the spread of pollen or seeds [3]. Around 3000 essential oils exist now, according to rough estimates. In fact, about 10% of these essential oils are important for cosmetics, food, and pharmaceutical products, as well as for agriculture. The Food and Drug Administration (FDA) recognizes them as generally safe. Different types of aromatic plants, varieties, and geographical regions can differ greatly in their chemical composition [3-5]. There are numerous studies on the essential oils suggested that they shows antimicrobial, antifungal, antiulcer, antihelminthic, antioxidant, anti-inflammatory and antifeedant property also cytotoxic, and antiviral activity, moreover ovicidal, molluscicidal, immunomodulatory, antinociceptive, repellent, insecticidal, sedative, and larvicidal effect [5-9].

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Antibacterial effects of essential oils

To prevent bacteria from reproducing and deterioration, a variety of fragrant herbs (and their essential oils) were utilised in the Ancient Egyptian embalming technique. The main compounds of essential oils, such as sesquiterpenoids, bisabolol, nerolidol, and farnesol, have been associated with many biological functions that can function as food-grade antimicrobial compounds. Furthermore, it has been documented that strong antibacterial activity is correlated with the presence of monoterpenes, eugenol, cinnamaldehyde, carvacrol, and thymol in essential oils [5, 6].

Several species of pathogenic bacteria have been resistant to essential oils, such as *L. monocytogenes, S. typhimurium, B. cereus, E. coli, S. dysenteria, L. innocua, S. Aureus,* and further numerous [5]. Aside from this, *Commiphora africana* essential Oil has been demonstrated to inhibit some pathogenic bacteria, including E. coli, C. albicans, H. pylori and S. Aureus [10]. H. Pylori is one of the most commonly encountered chronic infections among humans, has a high mobility and is a highly infectious agent such that it has been spread to nearly 50% of the world's population. Hepatitis-causing bacteria H. pylori are generally recognized as gastrointestinal pathogens. The chronic superficial gastritis associated with it can also damage the duodenum, which is responsible for causing duodenal ulcers [11].

An essential oil derived from *S. Hydrangea* leaves and flowers inhibits and resists a Gram-negative bacterium, Pseudomonas aeruginosa [12]. Researchers have also found that both clove and lime oils inhibit bacteria whether it is gram +ve or gram –ve [13]. According to one study, the essential oil of *Cymbopogon citratus* has appreciable antibacterial properties against some Gram-positive bacteria, moreover another study showed the essential oil of *C. nardus* to have broad spectrum antifungal properties against various fungi [14, 15]. A study proved to be the first to demonstrate significant antibacterial activity of essential oils on wound colonization bacteria in vitro and a reduction in wound healing delay similar to modern drugs tested in parallel [16]. In another investigation it was suggested that essential oil of tea tree was utilized to treat viral diseases [17].

Essential oils as antifungal agents

It is more difficult to determine the presence of fungi and treat them effectively when compared with bacterial infections because fungi are eukaryotic organisms. Due to the unique structure of chitin, which is absent from human cells, it is possible in many cases; antifungal agents can be made selectively toxic by targeting the cell walls of fungi.

Although most chemical treatments are effective, strains and species with intrinsic resistance can be developed. Depending on the amount of inoculums injected, the host's immunologic state, and the resistance of the fungal organism, the infection will start and worsen.

In most cases, antifungal drugs that are widely used in the clinical setting have some inherent drawbacks. In addition, they are very toxic, have a limited amount of efficacy, and are expensive; moreover, they have developed resistance to them; therefore, there is a great need for better antifungal with multiple structural classes, capable of targeting new targets selectively and with fewer side effects [18, 19].

Studies have shown that some essential oils from Thymus schimperi (Lamiaceae) can suppress a gamut rangy of fungi, including *P. chrysogenum, A. tubingensis, A.minutus, B. bassiana* and *M. gypseum,* which are all known to cause bacterial growth [20].

It has been reported that many essential oils are effective against pathogenic fungi in animals without harming them. Among natural products that have the potential to fungicidally resistant, essential oils may seem to be the most promising product [21]. There has been a large amount of research conducted on the antifungal properties of plants extracts. Essential oils are derived naturally from plants, with each species belongs to a specific family of plants. The essential oils are then classified according to their family structure [21].

A wide variety of essential oils derived from plants and herbs are known for having high levels of antifungal activity. Essential oil from cinnamon, basil, lemon, manuka, bay tree, peppermint, pine, and cedar leaf can act as antifungal properties[22]. Essential oils from *C. Macrolepis*, *M. Piperita*, *S. Fructicosa*, and *B. persicum* have been shown to suppress fungus growth in vitro in certain clinical investigations [22].

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There is a correlation between terpenoids and their antifungal activity, particularly phenolic terpenoids with their hydroxyl group. Among the compounds known for their antifungal properties are carvacol and thymol; by interacting with sterols, particularly ergosterol, the chemicals cause harm to the cell membrane. Phytochemically, carvacrol is a phenol derivative of cymene, which is a natural monoterpene, found in some oregano and thyme, causing damage to the membranes and causing the fungus to die, has proven to be highly effective against fungi [23].

In Citrus EOs and other plant-derived extracts, citronellal is a volatile constituent that has been clinically proven to inhibit fungi growth [23]. In comparison to cinnamon (which includes linalool), peppermint and basil, both contain methylchavicol and menthol; have inferior antifungal activities [24].

There are several sesquiterpene hydrocarbons and oxygenated sesquiterpenes that have antifungal properties in some cases, as well as alternative antifungal frameworks for drug development, since they are highly efficient and suffer from low drug resistance when compared to the whole EO.

There was evidence that several essential oils have significant antifungal activity against *Aspergillus flavus*, *Aspergillus ochraceus*, and *Fusarium* [25]. An increasing number of studies have demonstrated that the essential oils of oregano, thyme, clove, lavender, clary sage, and arborvitae may act as antifungals. These essential oils stop fungus like *Aspergillus fumigatus, Chaetomium globosum, Penicillium chrysogenum, Cladosporium cladosporoides, Alternaria alternata,* and *Cladosporium cladosporoides* from growing [26].

The essential oils of *Oreganum vulgare* (oregano) and *Thymus vulgaris* (thyme) have a strong antifungal effect against a variety of fungus [27]. Cinnamon, thyme, catnip, and tea tree essential oils had the most minuscule MIC and MFC significance of all the fungi examined. However, the MIC and MFC values for Laurel, clary sage (Salvia sclarea), and tea tree essential oils were the highest [28].

Essential oils as antioxidant agents

As the name suggests, antioxidants are substances which help prevent the oxidation of molecules inside a cell. Free radicals are formed as a by-product of the oxidation process in the body. When reactive oxygen species accumulate in cells, they can damage DNA, RNA, and proteins, at the same time triggering cell death. Reactive oxygen species can cause a variety of cellular changes, including aging-related disorders such as asthma, diabetes and Alzheimer's as well as cancer and thrombosis of the arteries [29, 30]. Free radicals are shielded from harm in nearly all of the body's cells by defence mechanisms [30]. It is entirely possible that this imbalance can result in the occurrence of an 'oxidative stress' phenomenon the product of the body's antioxidant system, which produces free radicals but also eliminates them. It is possible to restore a healthy balance between free radicals and antioxidants by providing extra amounts of antioxidants. Phytochemicals, such as phenolic compounds present in essential oils, make them an attractive target for researchers exploring their antioxidant or anti-free radical properties. A variety of essential oils exhibit terpene-rich antioxidant and radical scavenging effects at room temperature [31]. Compared with synthetic butylated hydroxytoluene (BHT), Thymus serpyllum essential oil showed similar free radical scavenging capabilities. It is believed that the high levels of thymol and carvacrol are responsible for the antioxidant activity [32].

According to one study, the antioxidant capabilities of lemon essential oil may be useful in reducing oxidative damage to the skin, which occurs as a result of both environmental and chronological aging [33]. In one study, it was found that long-term use of lemon essential oil with grapes seed oil effectively prevented lifestyle-related skin disorders [33, 34].

Essential oils as anti-inflammatory

Physical injury, toxic chemical compounds, and infectious microorganisms can all cause inflammation. The inflammation process is linked to many diseases, such as skin inflammation and autoimmune disorders. Herbal essential oils can reduce inflammation by suppressing inflammatory cytokines involved in multiple signalling pathways. It is envisaged that herbal essential oils will potentially act as anti-inflammatory drugs. In addition to the bioactive compounds found in essential oils, many of them have an anti-

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inflammatory effect, together with carvacrol, limonene, citronellal, and cinnamaldehyde [35-39].

Essential oils as Antiviral

There has also been a great deal of speculation about the possibility of developing plant-derived essential oils as antiviral medicines to treat a broad range of viral infections in humans and eventually replace synthetic antiviral treatments. In the literature review, it was reported that essential oils have powerful antiviral properties as they have been shown to be effective against several types of infection, including herpes simplex virus 1 and 2 (HSV-1 and HSV-2) and several types of influenza, dengue, and coxsackieviruses. Tea, eucalyptus, and thyme essential oils were reported to exhibit antiviral action against HSV-1 in an in vitro investigation. There has been evidence demonstrating an anti-dengue outcome of essential oils of Artemisia douglasiana and Eupatorium patens. Essential oils of Lippia junelliana along with L. turbinate have also been shown to have a strong antiviral effect, particularly against the Junin virus. In recent years, research has suggested that the chemical elements of essential oils can be utilised to build and construct medications to combat the COVID-19 virus [40, 41]. Essential oils have been reported to function against HSV-1/2, including alpha-eugenol and isoborneol, derived from S. album, A. aborescens, H. cordata, L. scoparium, Thymus vulgaris, Salvia fructicosa, S. limbata and S. sclarea, Santolina insularis, Artemisia, Lippia, and other species40. A group of researchers evaluated several plants for their ability to inhibit HSV-1 [41, 42].

As well as adenoviruses, dengue virus type 2, dengue virus type 2, human respiratory syncytial virus, yellow fever, tobacco mosaic and HIV, Newcastle disease virus and Junin virus, as well as a new Corona virus that caused SARS, have all been examined and tested against EOs and chemical compounds [40,41]. Antiviral activities of essential oils have been studied in several researches such as those involving dengue viruses, herpes simplex virus, and the Junin virus [43].

Essential oils as insecticide

Essential oils have the ability to repel insects and pests, and protect against infestations. Aside from being insecticidal and repellent, essential oils disrupt pest insect growth, reproduction, feeding, and oviposition as well. These essential oils and their constituents attract cockroaches, as well as other pests, and act as insecticides and repellents [44]. The essential oil is used as a pesticide and to repel insects and pests. Originally from India, the neem tree (*Azadirachta indica*) now grows throughout the tropics all over the world. In addition to its use as a shade tree and construction pole, it is also used as a medicine, tooth stick, and insecticide. It has been found that neem tree contains pesticidal properties and this has been studied thoroughly [45].

Furthermore, essential oils derived from *C. flexuosus, E. globulosus, R. officinalis, V. zizanioides*, *E. caryophyllus*, and *T.vulgaris* has been proven to have pest management qualities. Peppermint, on the other hand, is very effective at repelling ants, flies, lice, and mosquitoes. *Menthaspicata* and *Ocimum basilicum* leaves be too useful for repelling flies. A number of essential oils, from *Artemesia vulgaris, Melaleuca leucodendron, Pelargonium roseum, Lavandula angustifolia, Mentha piperita*, and *Juniperus virginiana*, have additionally been demonstrated to be effective against a variety of insects. As the evidence suggests, the oils derived from Mentha species are highly effective in combating against *Callosobruchus maculates* and *Tribolium castanum* [46].

Several studies have been reported on the potential of *Ocimum basilicum* as a pesticide. There are many essential oils in basil that are repellents, toxic, or inhibit the growth of insects [46]. Researchers have studied essential oils derived from eucalyptus and lemongrass for their toxicity, effectiveness, and antimicrobial properties. Essential oils from different plants have also been historically used for their wide range of pest control properties. Since ancient times, it has been found that *Cymbopogon winterianus* works as an insect repellent as well as an animal repellent. Citronella oil has been shown to be larvicidal primarily due to the monoterpene citronellal. It is known that the essential oil of *Vetiveria zizanioides* root protects clothes from insect damage [47]. The oil of the eucalyptus tree is also used as an anti-feedant, especially as a repellent to biting insects. Using eucalyptus-based products for human protection against biting insects has been reported. Eucalyptus oil was later found to be effective in preventing mosquito bites. Ticks and

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mites, whether parasitic or free-living, can be effectively dispensed by essential oils and their components [46].

Conclusion

Aromatherapy and conventional medicine both use essential oils as secondary metabolic products produced by plants. They have a variety of pharmacological and therapeutic properties as well. A significant number of essential oils contain bioactive compounds, some of which are capable of causing significant physiological effects. The results of this study indicate essential oils may have potential value as bioactive agents and may enhance the development of new drugs for various diseases. As a result, essential oils have the potential to expand from the realm of traditional medicine to the domain of modern medicine.

Conflict of interest

None of the authors have any conflict of interest to declare.

Consent for publications

All authors approved the final manuscript for publication.

Availability of data and material

Data are available on request from the authors.

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