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Review Article

A Review: Antibacterial Activity of Several Essential Oils Used in Saudi Domestic Markets Against Certain Bacterial Pathogens

Ahmad M Qumri[1]*, Salah EM Abo-Aba[1,2] and Faisal MB Al-Sarraj[1]

[1]*Department of Biology, Faculty of Science, King Abdul-Aziz University, Jeddah, Saudi Arabia*

[2]*Department of Microbial Genetics, Genetic Engineering and Biotechnology Division, National Research Centre, Dokki, Giza, Egypt*

***Corresponding Author:** Ahmad M Qumri, Department of Biology, Faculty of Science, King Abdul-Aziz University, Jeddah, Saudi Arabia.

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Abstract

Different researchers for their antimicrobial and antioxidant potential have explored essential oils. The oils are derived through steam distillation of target plants using ancient Arabian techniques to produce extracts with medicinal uses. However, their method of action against microbes is not as well understood as that of antibiotics. The problem of antibiotic resistance has further increased interest in studying essential oil and medical efficacy. Efforts to understand antimicrobial activity have focused on the disk diffusion method and their effectiveness measured using the minimum inhibitory concentration. The Kingdom has numerous flora, including herbs and aromatic flora, whose potential in native medicine should be explored. This review provides a detailed analysis of some medicinal uses of essential oil, as evidenced in past studies to show multifold biological activities of these oils. While many studies report the antimicrobial potency of essential oil, none, to the best of our knowledge, focuses on essential oils' chemical characterization from Saudi Arabia. This review aims to explore the antibacterial properties of several essential oils used in Saudi domestic markets against specific bacterial pathogens. The analysis will reveal the need for more studies to characterize the essential oils in Saudi Arabia and ensure their safety, effectiveness, and drug interactions.

Keywords: Essential Oil; Aromatic Plants; Antibacterial Activity; Bacteria

Introduction

Essential oils have been proven to contain certain antimicrobial properties that may be critical in solving problems associated with microbes such as bacteria, viruses, and protozoa [1-3]. Investigators have determined that some essential oils can be used directly to counter disease-causing microorganisms' pathogenic effects. Various mixtures of essential oils contain odiferous bodies, especially in vegetable-based organs. In most cases, the elements that contain such oils are the fruits, flowers, leaves, woods, and rhizomes [4,5]. Arabs have a long history of using essential oils in the healing of wounds and relieving upsets. Famous Arab physicians designed protocols that may be used to extract the active compounds from the essential oils as early as the 10th century.

Aside from this, researchers have undertaken several studies investigating antimicrobial compounds found in fungi and plants. Some of the studies have shown that the compounds may inhibit bacteria such as streptococci [6]. Many people around the world understand the benefits associated with plant-based oral health alternatives. A key benefit associated with such solutions is that they rarely have any negative side effects [7]. In addition to this, they tend to present benefits to an individual's health.

Understanding the physical and chemical structures of essential oils is critical in determining the extent to which they can be used to treat pathogenic conditions. However, one also needs to classify essential oils conventionally based on their origins and likely impacts on the human body. Essential oils are generally identified alongside their source plants. This means that the word "essential" stands for the association of the oil with its herbal origin. "Essential" does not mean that the oil will have a definite impact on a spe-

cific target microbe. While the term oil is generally used to refer to these extracts, some are produced in bases and compounds.

It is essential to observe that the compound's end-use may dictate the methods used for extracting essential oils. For example, steam distillation is popular in applications where the oil is targeted at pharmacology and food preparation [8,9]. Despite the existing applications of essential oils as antimicrobial products, the mechanisms through which these chemicals act against pathogens are still unclear in the scientific community. Another factor that makes the matter complicated is that a single variety of essential oil may contain many chemical compounds that act together against bacterial activity [1,10]. Some of the oils do not appear to target specific cells means that it is difficult to establish the actual activity without thorough research.

Various researchers have hypothesized the mechanisms through which essential oils contain bacterial infections. Some have observed that the compounds found in essential oils can penetrate the cell walls and cytoplasmic membranes of bacteria [11]. Upon penetration, they disrupt the polysaccharides, phospholipids, and fatty acids. This action leads to permeabilization and a change in the pH cells of the bacteria.

Scientists continue to investigate the antioxidant activity of the compounds contained in essential oils. Preliminary investigations have shown that essential oils act as herbicides, insecticides, antifungal agents, antibacterial agents, and disinfectants [12]. Some have suggested that the antimicrobial activity may be more significant than what synthetic antibiotics can offer. Other investigations have been launched into the impact of perfumes developed using essential oils for disinfecting the air.

Despite the limited pharmacological research into the activity of essential oils, various industries continue to use their products extensively. For example, essential oils are used in agronomy, sanitation, perfume pharmaceuticals, food, and cosmetic industries. Essential oils are also popular in preserving food and acting as additives. Most traditional medicine is based on the compounds found in essential oils, explaining why some traditional medical interventions have been so successful [13]. Understanding the chemical function of essential oils is critical in empowering various circles. These plants are preserved and conserved for use in solving medical conditions impacting human beings and animals.

Various industries will be in a position to extract valuable utility from herbs. For example, relying on lab-based chemicals to manufacture perfumes is less sustainable than using compounds extracted from plants. Additionally, plant-based perfumes, disinfectants, herbicides, and other extracts have fewer side effects, if any [14,15]. Investigating the active properties in plant oils has no negative impacts on any economic sector since modern industries do not utilize most herbs. Most plants are only used for aesthetics and air purification purposes regardless of where they grow.

Researchers observed that oregano, thyme, and sage are both antibacterial and antioxidant, depending on the situations in which they are used. Such products can be used to protect oils, fats, and similar products since they hinder oxidation [16]. Various industries are adopting the use of natural antioxidants due to health concerns. As more people learn about the benefits of natural products, natural antioxidants have grown in popularity across the world. Some of the benefits that have attracted institutions, industries, and individuals to such products include disease prevention, health promotion, and lack of side effects [17,18].

It should be noted that further investigating the effects of the compounds found in essential houses is not an option since individuals from various industries will continue to experiment with the products as long as they show some promise. This means that whether the scientific community takes up a task will not prevent individuals from experimenting with various essential oils for therapeutic purposes, disease prevention, health promotion, and disease management. It is unlikely that using plants as antioxidants, antifungal, insecticide, and anti-tumour products will slow down anytime soon.

Investigating the chemical structure of various compounds found in essential oils presents previously untapped benefits. For example, Rosemary and Origanum have been shown to contain hydroxyl groups in their structures, effectively tearing down bacterial structures [19,20]. Investigating these herbs and others may reveal that certain combinations of compounds can cure elements that have proved to be particularly challenging to the medical community. Researchers observed that some specific oils are only effective against pathogens to a specific extent [21,22]. Investigations may help unlock some of the unknown aspects of essential oils and hopefully fill the existing knowledge gaps.

Antibiotic resistance of pathogenic bacteria

The medical community has pointed out that pathogenic bacteria are continually showing resistance to antibiotics. The 20th century presented the world with some of the greatest achievements in pharmaceuticals [23]. Some of these gains are quickly getting swept away by the resistance that bacteria are showing to various treatments [24,25]. Studies show that antimicrobial resistance is becoming one of the leading causes of new infections worldwide. The phenomenon is also responsible for many health calamities in situations where physicians manage to respond with medicine that should typically work. There are some situations in which doctors have proven that some bacteria strains underwent structural modifications that made them resistant to antibiotics.

It follows that essential oils may one day be used as an alternative for antibiotics, especially given the rise of drug-resistant bacteria [26,27]. A key benefit of such a solution would be that the oils would be integrated into ordinary recipes so that individuals would not have to take them in the form of prescription medicine. Following the interest developed around essential oils a**s** antimicrobials, Avicenna's ancient distillation method has been investigated thoroughly. Researchers have observed that it entailed isolating the perfume from rose flowers in the form of rose water [28,29]. The extract would be used as a medicine capable of treating bacterial infections.

One of the worst aspects of antibiotic resistance is that bacterial genes are evolving continually. The implication is that public health could be seriously impacted in the future as more ailments prove impossible to contain [30]. Various researchers have observed that environmental reservoirs are likely to allow bacteria to develop resistance [31,32]. However, it is important to observe that resistance genes in human pathogens and environmental microbes are relatively rare. The implication is that deeper profiling of these environmental reservoirs is needed to determine the clinical impact of the genotypes associated with the microorganisms, leading to pathogenic resistance in humans.

Antimicrobial activities of essential oils

Some essential oils are known to produce antimicrobial agents that can assist in tracking infectious diseases. While some of the agents synthesize chemicals that induce chemotherapeutic processes, others contain natural substances that kill bacteria. One negative aspect of laboratory-prepared antibiotics is poor selective toxicity. It follows that natural antimicrobial compounds should possess the ability to kill bacteria selectively.

Researchers have developed various methods for usually antibacterial activity in essential oils. Despite this, it is important to observe no standardized approach to assessing the activity of antimicrobial compounds from essential oils against pathogenic microorganisms and food spoiling. This implies that there are several different experimental protocols used in proposing the applications of the concept in such fields. Another difficulty that researchers have encountered in comparing antimicrobial activities in the two fields is the multiplicity of factors that determine the effectiveness of essential oils. Some of the factors are inoculum volume, culture medium, temperature, incubation time, and the growth phase.

Extracting essential oils from plants varies in quality and quantity. Additionally, a specific herb's chemical composition may be determined by other factors such as age, vegetative cycle stage, and agro-climate. With the popularity of essential oils increasing, botanists will likely investigate the best conditions for growing high-quality plants and herbs capable of producing essential oils' excellent chemical compositions [33,34]. Increasing the yield without degrading the quality will significantly contribute to the fight against resistant bacteria [33,35]. It should be noted that both storage and handling also affect the quality of essential oils and determine their ability to act as antimicrobial agents.

Most grain-based essential oils are extracted from enclosed capsules containing seeds. Some are found in oil glands present in plants' cellular structure. As interest grows in the use of essential oils in fighting pathogens, commercialisation applications will continue to increase [36-38]. Researchers have observed that in some essential oils, the compound's major components may not be the ones responsible for the antimicrobial activities.

For instance, most unfractionated essential oils contain more antimicrobial properties than their isolated components [39,40]. The implication is that the elements containing antimicrobial activities may be found in trace amounts inside essential oils. The complexity of most essential oils could explain why the antimicrobial activity prevents bacteria from developing resistance as they do with most antibiotics. Such a property could be critical in the long-term protection of public health.

The most popular essential oils have been isolated from aromatic herbs commonly found in tropical and Mediterranean regions.

While the plant organs which mostly contain essential oils have been identified as the bus leaves, seeds and flowers, researchers have determined that the specific regions associated with the healing chemicals may be the epidemic cells, channels, and cavities [41,42]. Another important finding is that the herb's physical condition from which essential oils are extracted may not be as important as previously thought. Some plants have produced the highest quality of essential oils dried, others fresh, and others partially dehydrated.

Extracting essential oils from plant material is a delicate process since some effective compounds may be exposed to conditions that damage their structure. Despite this, various methods have been proposed for the process. They include distillation, cold-pressing, solvent extraction, and maceration [43,44]. The extraction method used depends on the rate at which oil diffusers in the plant tissue to the exposed surface where it can be collected using various processes [45-47]. In some situations, the end use of the oil is used to determine the method used to extract it from the plant tissue.

Today, the commonest methods for obtaining essential oils from plants are hydrodistillation and steam distillation [48-50]. Despite this, researchers have come up with several experimental oil extraction methods that include microwaves and liquid carbon dioxide [51,52]. Other methods entail the use of pressure distillation, which relies on hot steam or boiling water.

The future and objective

The review of past studies as has been discussed in this work revealed that essential oils obtained from many plants have gained much appreciation among different fields and researchers because of their multifold biological activities [53,54]. Although a huge number of plant species have been investigated for their essential oil potential and biological activities, however, to the best of our knowledge there are no earlier reports yet available regarding the detailed chemical characterization and evaluation of biological and antioxidant principles of essential oils from these selected in Saudi Arabia markets.

The future study will therefore undertake with the main objective to evaluate antimicrobial, characterize antioxidants of essential oils selected from domestic Jeddah Saudi Arabia market, and study their effects at molecular level.

Conclusion

Essential oils, as shown in most studies, have strong antibacterial activity against a range of microbes. Aromatic plants are known in many countries, with most being traditional herbs and spices. However, the aromatic plants contain important essential oils that have been applied for medicinal purposes since time immemorial. The increasing antibiotic resistance issue is creating a gap in addressing bacterial pathogens that cause disease in humans. Therefore, researchers are focusing on more sustainable and resistance-proof methods to deal with pathogens. The essential oils have been shown to have specific components that have bactericidal effects. Extraction using disk diffusion assays and measurements using the minimum inhibitory concentrations provides a basis for understanding essential oils' antibacterial activity. While the mechanism of action is still in question, some studies have shown effects on the cell membrane when essential oils are exposed to bacterial cells. Also, essential oils have shown antioxidant potential, which explains the widespread use of these oils in most parts of the world as herbal medicine. The present review has shown most of the studied uses of essential oils, efficacy, and active components. Most studies cite the role of phytochemicals in the antibacterial and antioxidant properties of essential oils. However, essential oils' safety, including their interaction with other drugs, still needs to be understood before considering pharmacological products for human use. Since the effectiveness of essential oils as antimicrobial agents requires a thorough knowledge of toxicity levels, modes of action, and degradation pathways in the human body, more studies are needed. Future studies should focus on characterizing the essential oils at a molecular level using new technological approaches in PCR to amplify any needed DNA segments. If the essential oils can be produced without contaminants, they can help fight against pathogens that cause human disease. As a prospective alternative to antibiotics, essential oils could pave the way for new drug discoveries that are ecofriendly and resistance-proof. Indeed, the potential of essential oils in the Kingdom of Saudi Arabia and the world should be explored at the microbial level to understand any antimicrobial activities.

Conflict of Interest

We declare that we have no conflict of interest.

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