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Essential oil extraction in food safety with implication fungistatic activity: A review

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Abstract

Antibacterial treatments currently used for treatment cause several side effects, and bacterial resistance to the antibiotics is also increasing. Therefore, there is need to find better alternatives. Essential oils (EOs) have been used for treatment of various ailments since ancient times and have gained popularity over the years. Safety and efficacy of EOs have been proved by several clinical trials. This review gives an overview on the EOs, their uses, and adverse effects.

Essential oils (EOs) are frequently utilized in the food industry as the best alternatives since they are more complex and contain a variety of volatile and natural bioactive ingredients. This review focuses on the use of EOs as natural preservatives in the production of food and the functions of their main constituents as well as the associated extraction mechanisms or methods. Additionally, the various therapeutic including antioxidant, antifungal, and antibacterial actions of EOs were reviewed.

Keywords: Essential oils, Food, avocado oil.

Introduction

The properties, applications, and benefits of essential oils are numerous. Essential oils are used to treat a variety of diseases, including infectious diseases, depression, and anxiety; they also have antifungal, antimicrobial, anticancer, and wound-healing properties. They are also utilized in the perfume and cosmetics industries. Essential oils are utilized more frequently in the health field, primarily when applied to external body parts to alleviate pain. Essential oils are utilized in the perfume industry because of their appealing scent; the majority of the essential oils are utilized in this sector. The global essential oil market is expanding rapidly and gaining importance on a daily basis due to its widespread use.

Topical

Some essential oils are used topically for their antiseptic and anti-inflammatory properties, such as for acne or fungal infections, while others are applied directly to the skin to alleviate pain in a specific body part, such as in the back, muscles, or sinuses.

However, many essential oils can be irritating, so they should be diluted in a carrier oil (such as almond, apricot kernel, or avocado oil) before being applied topically. Also, essential oils are sometimes used in massage and spa treatments and added to soap, lotion, shampoo, and bath salts.

Inhalation

Volatile compounds are what give essential oils their therapeutic properties and the strong, distinctive scent of a plant. Using an aromatherapy diffuser or a drop of oil on a piece of clothing, jewelry, or other objects, these volatile compounds are inhaled in aromatherapy. The safest way to use essential oils is inhalation. Essential oil molecules are thought to have an effect on the nervous system, limbic region of the brain, hormones, chemicals in the brain, and metabolism when inhaled.

Ingestion

Although this should be done with extreme caution, some essential oils can be used in cooking or even taken by mouth in small amounts as a medication. While some can be taken safely in small amounts, others are poisonous by nature and should never be consumed.

Basic Extraction Methods of Essential Oils

Distillation

It is the method used to extract the majority of common essential oils, including eucalyptus, peppermint, and lavender. An alembic, or distillation apparatus, is used to place raw plant materials like—flowers, leaves, wood, bark, roots, seeds, or peel—over water. The steam travels through the plant material and vaporizes the volatile compounds as the water is heated. After passing through a coil, the vapors return to liquid and are collected in the receiving vessel

Expression

The majority of citrus peel oils are cold-pressed or mechanically extracted. Citrus-fruit oils are less expensive than most other essential oils because they contain a lot of oil and are inexpensive to grow and harvest. The citrus industry produces by-products such as lemon or sweet orange oils.

Solvent Extraction

A technique for separating a compound into its components based on their solubility is solvent extraction. The solvent is mixed with the plant material during essential oil extraction. Petroleum ether, methanol, ethanol, and hexane are some of the most frequently used solvents. When raw plant material is delicate, like flowers, or when steam or water alone will not release their therapeutic essences, the solvent extraction method is used. The method is easy to use and works well. Eos used to integrate pest management of crops i.e. biological control is not a novel idea but has recently garnered a lot of interest. The current overuse of synthetic pesticides has negative effects on the environment and human health. As a result, people around the world are encouraged to use fewer pesticides and to use alternative methods and integrated pest management (IPM) systems.

Benefits to Health

Around the world, essential oils play a significant role in both traditional and folk medicine. However, many of the old claims about them are supported by modern medicine, including:

Stress Management

Aromatherapy uses a lot of essential oils to deal with stress and anxiety. For instance, researchers discovered that inhaling 2.5, 5, or 10 drops of orange oil had a calming effect on male volunteers' anxiety. Although more research is required, the initial findings were encouraging.

The antimicrobial properties of tea tree oil that have long been touted in traditional medicine have shown promising results in early studies. Athlete's foot, oral thrush, and fungal infections like candida have all been treated with the oil. Once more, more research is required.

Aid to Sleep

The calming scent of lavender oil is thought to improve sleep quality. On dementia-affected seniors, scientists tested this claim. They discovered that by sprinkling the essential oil on towels that were placed around their pillows, they were able to sleep for longer in the morning.

To Prevent Disease

Antioxidant properties can be found in many essential oils. Free radical damage to cells is prevented by antioxidants. This harm can prompt serious infections like a malignant growth. Foods infused with essential oils have been shown to extend the shelf life and increase antioxidant intake, according to researchers.

Risks to one's health

Even though essential oils are derived from nature and have been utilized for centuries, there are risks associated with their use. They must be used and stored in accordance with the specifications provided by the manufacturers because improper use can result in serious adverse reactions or even poisoning.

Innovative Approach

Essential Oil Formulation in order to legitimize and encourage the use of essential oils (EOs) in agriculture as "green pesticides", particularly in the context of agroecology, suitable options must be found to encourage their use, efficiency, and long-term effects. Particularly, it is frequently argued that the EO's field-of-use stability and time-dependent persistence of effects are limited. Due to the relatively low yield and expensive approval process, working with EO may also be an expensive option. In a recent study on rosemary essential oil, the starch coating has been proposed as a method for encapsulating the oil to control its diffusion and improve its effectiveness as a potential bioherbicide for use in the field.

EO Encapsulation

Another new technique, EO encapsulation, has the potential to improve EO stability and provide a controlled product release. There are various cycles prompting the obtention of either miniature or nano-containers. The process of coating a particle or molecule of interest or constructing a functional barrier between a core and wall material to prevent physical and chemical reactions between the core and outer molecules is the fundamental concept of EO encapsulation. This technique aims to prevent deterioration and preserve the core material's biological, functional, and physicochemical properties, such as EO. The two most common processes are spray drying and coacervation. The spray-drying technique is a common industrial encapsulation technique that offers the advantage of producing microcapsules in a relatively straightforward manner at a relatively low cost in comparison to other encapsulation techniques.

However, there is a drawback to the process because it must heat or evaporate during encapsulation, which is risky for essential oils. It is also possible to encapsulate liposomes, which are molecules that are amphiphilic and can "self-organize" into layers in aqueous media, defining multiple aqueous compartments. In various compartments, these liposomes are frequently utilized as carriers for other hydrophilic, lipophilic, or even amphiphilic molecules. Another cutting-edge method that offers the same benefits as those previously mentioned is encapsulation in solid lipid nanoparticles (SLN), which can be made of lipid or lipid-like molecules like waxes or triacylglycerols. SLN-encapsulated Artemisia arborescence EO was found to be significantly more stable than raw EO.

Synergistic effects of EOs

Incorporating lipid-based nanocarriers into the preservation of grains and related food products was one of the synergistic effects of EOs. Nanomaterials, which are typically used for the transportation of molecules ex. nanocarriers are used in drugs and natural phytocompounds. The diameter of the nanocarriers ranges roughly from 1 to 1000 nm. Notably, the potential effects of nanotechnology on the antimicrobial delivery system have piqued the interest of numerous researchers in recent years.

Current use of essential oils in active food packaging

Essential oils are widely used in the food industry because of their natural antimicrobial, antioxidant, or bio-preservative properties, which help foods last longer. Other groups of foods, such as fish products, meat products, milk and dairy products, bread and baked goods, and vegetables, are also common sources of essential oils. However, due to the interaction between their unstable, volatile composition and external factors like light, oxidation, and heating, essential oils begin to degrade rapidly when added directly to the food matrix. Essential oils can now be encapsulated in liposomes, polymeric particles, and solid lipid nanoparticles to increase their stability thanks to new technologies.

Effect of essential oil incorporation on the micro structure of the food packaging material: Scanning electron microscopy (SEM) or transmission electron micro scopy (TEM) can be used to observe the micro structure of the food packaging material incorporated with active compounds like essential oils. SEM utilizes an electron pillar to examine the design of eatable movies with medicinal oils and contrast it with the development of a film that doesn't contain lipids. Biodegradable packaging and edible films typically contain polysaccharides and proteins, in contrast to the majority of non-polar plastics used in conventional food packaging.

The material used in packaging is biodegradable if it completely breaks down or breaks down into natural elements when it is disposed of. The edible material, such as lipids, polysaccharides, or protein, is used to make edible films or coatings. After pouring an aqueous solution onto a flat surface and drying at a constant temperature, these edible films or coatings form. Various processes, such as emulsification and homogenization, can be used to incorporate essential oils into the edible film matrix. Essential oils with polymer tend to form fine emulsions in the aqueous phase, while lipid droplets are incorporated into the polymer structure in dried films. The final microstructure of the packaging material is influenced by the structural arrangement of the components. During the drying process, coalescence, creaming, and droplet flocculation can alter this microstructure. Essential oil loss is also affected by the polymer-forming film. Because of this, the polymer-essential oil interaction improves emulsion stability, resulting in a significantly improved film microstructure.

According to the findings of the study, HPMC films that contained ginger essential oil had a more open structure and were thicker than films that did not contain any essential oils.

According to the findings of another study, the addition of essential oils such as thyme, lemongrass, and sage to alginate films results in surface roughness. The food packaging material's final microstructure can also be determined by its composition. For instance, films made with sodium caseinate and a small amount of the essential oils of ginger and cinnamon. The study demonstrated that droplets of ginger oil were observed in the cinnamon oil-homogeneously distributed protein matrix.

The fact that different way of behaving makes the end drawn both medicinal oils causes primary contrasts in the film during drying and result from the mind-boggling communications occurring between the lipid, the protein, and the dissolvable. The aroma of lemon essential oil after seven days of storage.

EOs and their constituents have a significant impact on antimicrobial activity

EOs significantly cross the lipids of bacteria's cell membranes, disrupting the structures of the cell wall and making them more permeable due to their hydrophobic nature. Ions and other cellular materials leak as a result of this change in membrane permeability, causing the death of cells. The activities of EOs can be single or multiple. One of the most important EO compounds, trans-cinnamaldehyde, for instance, can inhibit the growth of S. typhimurium and E. coli by depleting intracellular ATP levels. Additionally, it gains access to the cell's periplasm and deeper regions. Another important component of EOs is carvone, which affects cellular ATP pools but not the outer membranes of the cells. Cinnamaldehyde, citral, carvacrol, eugenol, or thymol, which belong to the phenol and exhibit significant antibacterial activity, are strongly correlated with the presence of major compounds. Terpenes and other compounds, such as ketones (-myrcene, -thujone, or geranyl acetate), exhibit weaker activity, and hydrocarbons are mostly inactive. The primary active compounds, carvacrol, eugenol, and thymol, effectively inhibit microorganism growth by disrupting cell membranes, causing changes in electron flow, the driving force of protons, active transport, and the coagulation of cell contents.

Result

Even though essential oils have such a wide range of uses and benefits, they can also cause side effects like allergies, inflammation, burning, and headaches, among other things. There is currently no research supported by evidence demonstrating that essential oils can completely treat any illness. The findings regarding the other potential advantages of essential oils, such as elevating mood or relieving stress, are more mixed. However, the majority remain inconclusive.

However, clinical trials have not yet been included in the majority of these studies. As a result, essential oil research needs to be expanded to make new discoveries. In order to lessen the impact that microbial activities have on food products, a variety of essential oils (EOs) and their individual components are utilized as natural antimicrobial compounds.

There are a number of packaging technologies that aid in food quality preservation. Due to their positive effects on resolving ecological issues and increasing consumer acceptability, more cutting-edge strategies like active packaging surpass conventional packaging technologies.

Even though active packaging can contain synthetic additives, bioactive compounds like essential oils in biodegradable materials for active food packaging are gaining popularity. As a means of enhancing both their biological activity and stability, new emerging techniques like EO formulation through emulsion or encapsulation may enable EO to appear on a larger scale, with considerations, but from an economic standpoint. In this regard, both techniques may represent novel strategies for the commercialization of EO as viable biocontrol products. Using EO, which is preferentially formulated in accordance with the preceding considerations, in conjunction with synthetic pesticides in a traditional pesticide crop management system could be a feasible and gentle transition that would allow for a reduction in the amount of pesticides required for an integrated pest management system.

Conclusions

As described in this review, there is considerable evidence that EOs have potential to be developed as preventive or therapeutic agents for various oral diseases. Although several other potential uses of EOs have been described and many claims of therapeutic efficacy have been validated adequately by either in vitro testing or in vivo clinical trials, still there is need for conducting further research to establish the safety and efficacy of these EOs before including them in clinical practice. If used properly, they may prove very useful in dental therapy and may contribute in improving the quality of dental treatments.

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