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Usage of Essential Oils of Natural Herbs as Food Preservatives

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ABSTRACT

One of the most issues that face the food production industries is the manufacture of healthy food products without synthetic preservatives due to the fact that artificial antibacterial agents and chemical additives could have serious detrimental impacts on people's life quality. Essential oils (EOs) extracted from various plant origins have received huge attention because of the possible health benefits. Essential oils are complicated combinations made up of numerous distinct chemicals isolated using various methods. Such chemicals demonstrated substantial biological functions like antioxidant and antibacterial activity through a variety of mechanisms, and they are less dangerous and pose no health problems to humans. In this article, we underline the importance of Essential oils such as major ingredients and sources, antibacterial activities, and potential uses in the food sector. The use of natural additives is becoming more common; nonetheless, they may have negative effects on organoleptic properties. As a result, more research is needed to adjust the dosages used to effectively stop the growth of microbes is still needed.

INTRODUCTION

EOs, commonly referred to as volatile EOs, are aromatic oily substances collected from plants' leafs and peels. Squeezing and steam distillation are two methods for extracting it from plant materials. Steam distillation is widely utilized, especially in commercial production (Lira et al., 2009).

The types and concentrations of the substances that make up these oils determine their aroma and flavor, which are different in the oils that are found in many different plants. Additionally, different plants produce varied amounts of EO, which affects the price of the oil. The original dyes help to alter the color of the EO because this can impact how the oils are used in particular foods. EOs are recognized to offer antioxidant and antibacterial effects as food additions. They can also be employed as active ingredients in packing polymers to enhance their characteristics, especially the water vapor barrier feature linked with EOs' hydrophobic nature.

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Consumer worries about synthetic preservatives have raised interest in organic antibacterial like EOs, which they have food preservation characteristics against a large number of infections (Sonker et al., 2015).

Chemical composition of Essential Oil

Many plants contain EOs, however the part that are the primary source of these oils vary. Plant EOs are typically a mix of polar and non-polar natural ingredients (Masango, 2005). Each oil typically comprises more than a hundred constituents, but the amount of ingredients varies based on the plant that have taken the oil from. However, the most important active chemicals are classified as Terpenoids like (Monoterpenoids and Sesquiterpenoids), and Phenylpropanoids. Both of these categories are formed from distinct main metabolic substrates and are generated via separate metabolic processes. EOs, like all organic chemicals, are formed of hydrocarbon atoms and can be categorized as phenols, terpenes, alcohols, esters, aldehydes, and etc.

The two main components of EOs found in a variety of plants and flowers are terpenes and terpenoids. The monoterpenoid and sesquiterpenoid groups of terpenoids provide the most important ingredients of EOs for most plants (Delgoda, 2017).

Almost all EOs contain Monoterpenoids, which have a structure of 10 carbon atoms and at minimum a double bond. Geraniol in lilac, myrcene in hop, linalool in lavender, and pinene in pine are some examples of Monoterpenes (Breitmaier, 2006). Citrus oils are short-lived because they are high in monoterpene hydrocarbons, react quickly with oxygen, and are easily oxidized (Swamy *et al.*, 2015).

Esters are commonly present in a range of EOs and are produced when an alcohol combines with an acid solution (a process named esterification). They have therapeutic properties such as being sedative and antispasmodic. Linalyl acetate is a commonly found ester in lemongrass, lavender and petitgrain EO, also geraniol acetate spotted in sweet marjoram, is among the advantageous components in EOs (Arumugam *et al.*, 2016). Certain esters have antifungal and antibacterial characteristics, such as geranium oil's antifungal effects (Lang and Buchbauer, 2012).

Essential Oils in the food industry

Refrigeration, frozen storage, drying, salting, smoking, and fermentation are all traditional ways of food preservation (Dave and Ghaly, 2011). However, because of the rising desire for low-salt foods, consumers have criticized procedures such as fermentation and salting (Jayasena and Jo, 2013). The meat industry uses chemical additives like nitrate salt, sulfites, and chlorides to limit the spread of microorganisms that are found in food. These chemicals have a history of causing cancer and other health problems (Jayasena and Jo, 2013). Natural substances have gained popularity as alternatives to artificial preservatives in recent years. In their review Lucera *et al.* (2012) clarified several natural preservatives such as (lactoferrin, lysozyme) derived from animals, bacteriocin from microbial (natamycin, nisin), polymers derived from nature like (chitosan), acidic organic compounds (citric and propionic acid), EOs from plant parts.

Academic researchers have shown that EOs can successfully replace artificial preservatives in various diets (Valková *et al*., 2021; Ahmed *et al*., 2021; Radünz *et al*., 2020). Several studies have looked into the possible benefits of EOs/extracts to increasing the lifespan and inhibiting pathogen development in fresh veggies mixtures (Kraśniewska *et al*., 2020), fruit juices (Siddiqua *et al*., 2015), cooked meat (Huq *et al*., 2015), and turkey (Vasilatos and Savvaidis, 2013). Many papers focused on the usage of EOs in food products, included over 650 studies on fruit, 403 studies on veggies, 415 studies on seafood, 410 studies on beef, 216 studies on milk, and 97 studies on bread and baked products (Fernández-López and Viuda-Martos, 2021). Additional latest studies have looked at the use of rosemary extract in beef (Kaur *et al*., 2021), the combined effect of EOs in fish conservation (Huang *et al*., 2021), food packaging (Carpena *et al*., 2021) and as a natural preservative (Falleh *et al*., 2020).

Fruits and veggies can be preserved to extend their life span through spraying, soaking, coating, and impregnation (Lucera *et al.*, 2012). A study investigated the impacts of socking cherry tomatoes in a nanoemulsion of thyme EO against *E. coli*, and the influence of this emulsion combined with ultrasound treatment (He *et al*., 2021). The investigation revealed that the nanoemulsion by itself can successfully stop the development of *E. coli* on the cherry tomatoes' skin, and the co-treatment had a significant synergistic impact. According to (Kang and Song, 2018), newly cut red mustard leaves that had been rinsed with a nanoemulsion of cinnamon leaf EO had a two-log reduction in the amount of *E. coli*, *L. monocytogenes*, and *S. enterica*. Further investigation from the same researcher revealed that washing with a nanoemulsion of cinnamon leaf EO improves physical separation and inhibits both *Escherichia coli* and *Listeria monocytogenes* on cabbage leaves (Kang *et al*., 2019). The quality features of mustard (Kang and Song, 2018) and cabbage leaves (Kang *et al*., 2019) did not demonstrate any negative alterations in the two studies. Lettuce leaves were evaluated after 7 days of storage and found to have reduced *E. coli* levels when washed with a mix of carvacrol - thymol/eugenol comparing to the untreated group (washing with water), as well as unfavorable impacts on sensory qualities (Yuan *et al.*, 2019).

Another study reported the use of a mixture of Spanish oregano oil and Spanish marjoram oil succeeded in inhibiting *listeria monocytogenes* bacteria from a variety of freshly cut veggies without displaying any unfavorable sensory traits (Kraśniewska *et al*., 2020). According to Dai *et al*. (2021), reported that *Litsea cubeba* EO was applied to cucumbers, carrots, and spinach at the minimum inhibitory doses reduced the number of *Escherichia coli*. The antimicrobial ability of isogenol and coated isogenol against many microbes, fermentation-associated lactic acid bacteria and *Pseudomonas fluorescence* in carrot juice were examined, their investigation found no significant variation in the inhibitory action, contrary to predictions (Nielsen *et al*., 2017).

Aside from fruits and vegetables, the antibacterial capability of EOs in beef products, particularly meat products, has received considerable attention (Yoo *et al*., 2021; Khaleque *et al*., 2016). Pistachio EO (Krichen *et al*., 2020) and tea tree EO (de Sá Silva *et al*., 2019) decreased the total number of *L. monocytogenes* in minced meat. The potential of (5, 10%) of clove EO in inhibiting *L. monocytogenes* in minced beef stored at chilling and freezing temperatures were studied, and he noticed that ten percentage of clove EO was a deadly dose for inactivating *L. monocytogenes* regardless of thermal circumstances, but five percentage of clove EO failed to eliminate the pathogen (Khaleque *et al*., 2016). Neither *E. coli* nor *S. aureus* were significantly reduced in beef as reported by Yoo *et al*. (2021), when used clove EO at (0.5, 1.0 and 1.5%) concentrations. Nonetheless, their research went a step further and revealed that the combination of clove EO with enclosed atmospheric pressure had a bactericidal impact on the two pathogens. Similarly, another study has discovered that chrysanthemum EO mixed with chitosan nanofibers stopped *L. monocytogenes* growth in meat at an average of almost 100 percent (Lin *et al.*, 2019). A mixture of thyme, cinnamon and clove EO in food matrix was originally used practically by Chaichi *et al.* (2021), the triple mixture at FIC 0.3, 0.39, 0.43 had an impact on *Pseudomonas fluorescein* injected into chicken breast meat, while the mix at a dose of (200 mg/kg) had an immediate antimicrobial impact. As for thyme EO, it effectively stopped the growth of the bacteria *Pseudomonas fluoresce*, *Escherichia coli* and *Salmonella enterica* in ground meat (Jayari *et al*., 2018). Other research publications indicated that nanoemulsions of EOs efficiently suppressed infections in salmon fillets (Kazemeini *et al*., 2019) and chicken breast fillets (Noori *et al*., 2018). In addition to fruits, vegetables, animal products, Eos have been applied and evaluated in baked goods (Khezri *et al*., 2021; Valková *et al*., 2021) and dairy products (Ahmed *et al*., 2021). Table 1 covers some research findings on the application of EOs as a preservative.

Table (1): Latest studies of EOs application as a preserver in the food sector

Plant source	Food applied	Condition of storage	Findings	References
Garlic EOs	Yogurt	30 days at 4ºC	Demonstrated its promise as a natural food preservative against *E.coli*	Nazari *et al.* (2019)
Mentha piperita	Stored minced meat	21 days at 4ºC	Effective against microbial growth and improved sensory acceptability, prolonging the lifespan of meat by roughly 7 days.	Smaoui *et al.* (2016)
Rosmarinus officinalis L	Tomato juice	15 days at 5 ºC	The antibacterial capabilities of EOs encapsulated by b-CD were preserved during the pasteurization of tomato juice.	Garcia-Sotelo *et al*. (2019)
Piper betleL	Raw apple juice	15 days at 4ºC	In refrigerated circumstances, treated juice increased a 6-day lifetime as compared to untreated juice.	Basak (2018)
Pulicaria inuloides	Fillet Fish	12 days at 10 ºC	The results showed that the EOs eradicated the majority of the microorganism. It also extended the lifespan of seafood.	Al-Hajj *et al.* (2017)

Conclusions and recommendations for future work

In this review, we examined the research on EOs and their significance in the food sector, as well as some of the primary active components, as well as their implementations in the food industry as a preservative technique to prolong the lifespan of foods. It's worth noting that EOs are venturing into a variety of fields. Various studies have shown that several EOs can be utilized as food preservatives, which are often more abundant and have lots of advantages like antibacterial and antioxidant properties, as well as a variety of ways by which they can impact foodborne organisms. The presence of phenolic natural compounds in EOs makes them a vital and healthy option to artificial preservatives and chemical additives, and their presence has proved a substantial ability to resist pathogenic bacteria and other germs without causing nutritional loss.

In general, there are numerous obstacles to the applications of EOs in food industry. For instance, antibacterial effect in EOs can be reduced because of many factors that can impact the contents of EOs like geographic location, plant diversity, harvest, way of extraction, and others that can lead to a reduction in EOs implementation. Additionally, it should be noted that EOs have a strong taste and smell, which might alter the flavor and aroma of foods. As a result, investigations should concentrate on the lowest quantity of EO required to retain antibacterial action without altering the organoleptic properties of food products.

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استخدام الزيوت الأساسية للنباتات الطبيعية كمواد حافظة للغذاء

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الزيوت الأساسية، حفظ الأغذية، سلامة الاغذية، الاعشاب الطبيعية.

الخلاصة

أكثر المشكلات التي تواجه صناعات إنتاج الغذاء هي تصنيع منتجات غذائية صحية بدون مواد حافظة صناعية نظرًا لحقيقة أن العوامل المضادة للبكتيريا الصناعية والإضافات الكيماوية يمكن أن يكون لها آثار ضارة خطيرة على جودة حياة الناس. حظيت الزيوت الأساسية المستخرجة من أصل نباتي باهتمام كبير بسبب الفوائد الصحية المحتملة، حيث أن الزيوت الاساسية تتكون من مكونات معقدة تشمل العديد من المواد الكيميائية المتميزة المعزولة باستخدام طرائق مختلفة، وقد أظهرت هذه المواد الكيميائية المتنوعة وظائف بيولوجية كبيرة مثل النشاط المضاد للأكسدة والبكتيريا من خلال مجموعة متنوعة من الآليات، وهي أقل خطورة ولا تسبب أي مشاكل صحية للإنسان. تركز هذه المراجعة على أهمية الزيوت الاساسية من حيث المكونات والمصادرها، والأنشطة المضادة للبكتيريا، والاستخدامات المحتملة كمواد حافظة في صناعة الأغذية. أصبح استخدام المضافات الطبيعية أكثر شيوعًا؛ ومع ذلك ، قد يكون لها آثار سلبية على الخصائص الحسية. لذلك ، لا تزال هناك حاجة إلى مزيد من البحث لضبط الجرعات المستخدمة لوقف نمو الميكروبات بشكل فعال.