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Mini Review

Essential Oils: An Emerging Trend in Food Preservation

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Abstract

Essential oils are extracted from oil 'sacs' in flowers, leaves, stems, roots, seeds, wood and bark. They differ significantly from the well-known vegetable, nut and seed oils which are made up of various fatty acids (essential oils are not). Essential oils are used by the plants in somewhat the same way they are by humans - they fight infection, contain hormone-like compounds, initiate cellular regeneration, and work as chemical defense against fungal, viral, and animal foes. Despite their foliar origins however, essential oils have a similar structure to some compounds found in blood and tissues, allowing them to be compatible with our own physiology. The traditional technologies pertaining to essential oil processing are of great significance and are still being used in many parts of the globe. Although the food industry primarily uses essential oils as flavorings, they represent an interesting source of natural antimicrobials for food preservation. However, application of essential oils as food preservatives requires detailed knowledge about their properties. The purpose of this review is to provide an overview of implementation of essential oil constituents as natural food preservatives in foods

Keywords: *Essential Oils; Food Preservation*

Introduction

Essential oils are concentrated volatile aromatic compounds produced by plants - the easily evaporated essences that give plants their wonderful scents. Unlike fatty oils, these "essential" oils are volatile, highly concentrated, substances extracted from flowers, leaves, stems, roots, seeds, bark, resin or fruit rinds. These oils have potent antimicrobial factors, having wide range of therapeutic constituents. These oils are often used for their flavor and their therapeutic or odoriferous properties, in a wide selection of products such as foods, medicines, and cosmetics. Essential oils cannot be substituted with synthetics. Only pure oils contain a full spectrum of compounds that cheap imitations simply cannot duplicate.

Pharmacological properties of essential oils

1. **Antiseptics:** Essential oils have antiseptic properties and are active against a wide range of bacteria as well as on antibio-resistant strains. Moreover, they are also known to be active against fungi and yeasts (Candida). The most common sources of essential oils used as antiseptics are: Cinnamon, Thyme; Clover; Eucalyptus; Culin savory; Lavender. Citral, geraniol, linalool and thymol are much more potent than phenol. œ
2. **Expectorants and diuretics:** When used externally, essential oils like (L'essence de terebenthine) increase microcirculation and provide a slight local anaesthetic action. Till now, essential oils are used in a number of ointments, cream and gels, whereby they are known to be very effective in relieving sprains and other articular pains. Oral administration of essential oils like eucalyptus or pin oils, stimulate ciliated epithelial cells to secrete mucus. On the renal system, these are known to increase vasodilation and in consequence bring about a diuretic effect.

3. **Spasmolytic and sedative:** Essential oils from the Umbellifereae family, Mentha species and verbena are reputed to decrease or eliminate gastrointestinal spasms. These essential oils increase secretion of gastric juices. In other cases, they are known to be effective against insomnia.
4. **Others:** Cholagogue; anti-inflammatory; cicatrizing

Essential oils in food preservation

Food-borne diseases are a growing public health problem worldwide. It is estimated that each year in the United States, 31 species of pathogens cause 9.4 million cases of food-borne illnesses [1]. Successful control of food-borne pathogens requires the use of multiple preservation techniques in the manufacturing and storage of food products. A recent consumer trend toward preference for products with lower salt and sugar content presents an increased need for efficient food preservatives, as lowering the salt and sugar content would otherwise compromise the product's shelf-life [2]. A wide range of preservatives are used to extend the shelf-life of a product by inhibiting microbial growth. However, an increasingly negative consumer perception of synthetic food additives has spurred an interest in finding natural alternatives to the traditional solutions[2]. Although originally added to change or improve taste, the antimicrobial activity of essential oils makes them an attractive choice for substituting synthetic preservatives.

Antimicrobial activity of essential oil

Plants produce a variety of compounds with antimicrobial activity. Some are always present while others are produced in response to microbial invasion or physical injury. Identifying the most active antimicrobial compounds of essential oils is cumbersome because essential oils are complex mixtures of up to 45 different constituents [3] and the composition of a particular essential oil may vary depending on the season of harvest, and the methods used to extract the oil [4-7]. Essential oil constituents are a diverse family of low molecular weight organic compounds with large differences in antimicrobial activity. Essential oils contain a number of different degradation products originating from unsaturated fatty acids, lactones, terpenes, glycosides, and sulfur- and nitrogen-containing compounds. Two examples of sulfur- and nitrogen-containing compounds with known antimicrobial activity are allicin and allyl isothiocyanate (AITC). Allicin (diallyl thiosulfinate) is found in garlic and plays an important role in plant defense (Ankri and Mirelman, 1999). Inside the garlic cloves, the amino acid cysteine is converted to alliin (S-allyl-l-cystein-S-oxide), a known sulfoxide with no antimicrobial activity[8]. Conversion of alliin to the antimicrobial allicin requires the enzyme alliinase. Studies suggest that alliin and alliinase are located in two different compartments [8] and when garlic cloves are crushed, alliinase comes into contact with alliin and produces allicin [8]. Allicin has a pungent smell of garlic and exhibits antibacterial, antifungal, antiparasitic, and antiviral properties [9].

Future prospect

The way forward In light of the above discussions, it is imperative to focus on multidisciplinary approaches to resolve the foregoing limitations of EO-based preservatives and in the development of cost effective natural preservatives to enhance the shelf-life of food items.

Role of modern science and technological innovations

EOs often have strong efficacy as preservative agents, their high cost compared to available synthetic pesticides and threat of biodiversity losses of aromatic plants demand diversified use for sustainable food preservation. Therefore, trans-disciplinary approaches using multi-level collaboration between science, technology and innovation at local, national and global levels are needed. The use of recent biotechnology approaches co-adjuvant with combinatorial chemistry; nanotechnology, active packaging system, and edible coating significantly expand the application domain of EO-based preservatives in food industries. Biotechnological and combinatorial chemistry in the past decade, biotechnological and combinatorial chemistry approach has become a major focus of research activity for accelerating the development of novel bioactive compounds. Elucidation of the metabolic pathways and precursors of volatile organic chemicals can play a significant role in the generation of commercial aroma chemicals which could reduce the requirement of raw materials from traditional agricultural sources. The recent innovation in biotechnological approaches could provide a metabolic map for the genetic engineering of essential oil formation [11]. Lange., *et al.* [12] have reported the potential utility of metabolic engineering and functional genomics for the sustainable production of cost-effective, high-quality peppermint EO. According to Berger [13] more than 100 commercial aroma chemicals have been successfully derived using biotechnology approaches. In addition, application of recent combinatorial chemistry could be used to design newer, desired semi-synthetic analogue of the natural compound by changing the stereochemistry profile. Several synthetic antimicrobial, antioxidative, aflatoxin binding peptides, flavour compounds, enzyme inhibitors, unnatural polyketides and carotenoids with desirable and useful properties have been synthesized by combinatorial chemistry approaches [14].

Active packaging and bioactive edible coating

Nowadays, active packaging and edible coating has gained significant attention by the food industries as an alternative method for controlling food spoilage. Recent literature has revealed that EOs and their bioactive components have pronounced efficacy in food packaging materials as a source of antioxidant or antimicrobial agents [15,16]. WasapowerTM is a well-known commercialized example of antimicrobial packaging using wasabi extract (roots of Wasabia japonica) developed by Sekisui Plastics Co, Japan [16]. Edible coatings containing EOs can extend the shelf life of applicable foods at an effective lower concentration than that applied directly to product surfaces. Ponce., *et al*. [17] have reported that the edible coating of chitosan enriched with rosemary and olive oil improves the antioxidant protection of the minimally processed butternut squash without affecting its sensorial properties.

Conclusion

Essential oils and their bioactive compounds can be exploited as natural food preservatives. The recent innovations in science and technology such as combinatorial chemistry, biotechnological advances, nanoencapsulation, edible coatings, and controlled release system could successfully address the existing limitation of EOs as food preservatives. Essential plant oils are on their way to revolutionizing food preservation. With essential oils, food preservation can be kept simple and non-toxic, and can actually benefit one's health. The oil's antibacterial properties can keep foods contaminant-free and boost the body's antimicrobial defense system. The antioxidant properties of some essential oils can give foods a longer shelf life while providing anti-aging properties to the consumer. It is imperative for any new preservative that regulatory authorities should recognize its potential, including the prioritized actions in terms of toxicology, environmental fate, exposure, and product chemistry to assure its safety and quality. Therefore, a healthy collaboration among the scientific community, industries and regulatory authorities is required for the development of the natural/EO-based preservatives and their commercialization.

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