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Application of some essential oils to control of fungi in UF feta cheese

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ABSTRACT

Mould growth on cheeses should be inhibited by some preservation methods, such as chemical food preservatives. But consumer perception that the use of industrially synthesized food preservatives may be associated with potential toxicological problems has generated interest in the use of naturally occurring compounds. Some certain herbs, spices or their oils with well known antimicrobial properties have been used for a long time in some foods such as cheese to prevent fungal growth. Mold growth except mould-ripened cheese varieties on the cheese surface causes undesirable flavor, economic loses and quality problems which of them are capable of producing toxic secondary metabolites. The genus most frequently isolated was *Penicillium* sp. producing mycotoxins such as ochratoxin-A and citrinin as responsible for spoilage in cheeses. In the present study, a search was evidenced essential oils that could safely be used as natural alternatives for chemical fungicides. This is a consumer pressure to reduce the use of such preservatives and perhaps replace them with other more natural ones. They could be used by the food industry as antifungal agents without toxic risk. Eos or their products could be treated with cheeses in order to protect from fungal contamination, so the using of some essential oils treatment on the surface of cheeses for inhibiting undesired fungi may be an alternative protection instead of chemical in future.

KEYWORDS

Essential oils;
Fungi;
UF feta cheese.

INTRODUCTION

One of the greatest challenges that UF feta cheese manufacturers face is product return as a result of mold growth. Mold spoilage is commonly attributed to the increased surface area of the cheese shreds and the extra handling and exposure that the shreds experience in the cut and packing facility. In addition to enforcing good manufacturing practices and preventing packages that leak, manufacturers have rather limited methods for reducing the opportunity for mold growth in shredded cheese[1]. In addition to an economic problem, mold growth on cheese must also be treated as a potential health hazard.

Importance of using essential oils as natural preservatives to control fungal in cheeses

The use of synthetic fungicides to control cheese spoilage moulds has been discouraged due to their effects on cheese, carcinogenicity, teratogenicity, high and acute residual toxicity, long-term degradation, and other side-effects in humans[2]. One of the major problems related to the use of these chemicals is that the fungi develop resistance. The use of higher concentrations of chemicals, to overcome the microbial resistance further enhances the risk of high level toxic residues in the products[3].

In spite of the modern improvements in food hygiene and food production techniques, food safety is an increasingly important public heal this sue[4,5]. It has been estimated that as many as 30% people in the industrial is edcountries suffer from food borne diseases each year, and in 2000 at least two million people died of diarrhoeal diseases worldwide[6]. Therefore, are still needed new methods for the reducing or inhibiting food borne pathogens, possibly in combination with the existing methods (the hurdle principle, packaging under modified atmosphere, heating, refrigeration, the addition of antimicrobial compounds)[6,7,8]. The antibacterial activities of essential oils of garlic, clove, thyme, basil, orange, vervan, and savage carrots in culture media were reported by several researchers[7, 9,10, 11, 12,13].

Especially the industrial is edsocieties appear to experience the trend towards green consumption, desiring fewer synthetic food additives and products with a low impact on the environment[6, 14]. For this reason there, is scope for new methods of producing safe foods that have a natural or green image. Another problem is the use of animal wastes as organic fertilisers, whether inorganic or non-organic agriculture, that gives rise to concerns about the possible contamination of agricultural produce with pathogens and the possible contamination of ground and surface water[13]. One of such possibilities is the use of essential oils for different reasons[6,8,15, 16].

Biological activity of essential oils

Essential oils from aromatic and medicinal plants have been known since antiquity to possess biological activity, notably antibacterial, antifungal, and antioxidant properties[17,18,19]. Biological activity of essential oils depends on their chemical composition, which is determined by the plant genotype and is greatly influenced by several factors such as geographical origin and environmental and agronomic conditions[20,21]. Many species and herbs exert antimicrobial activity due to their essential oil fractions. Some scientists reported the antimicrobial activity of essential oils from oregano, thyme, sage, rosemary, clove, coriander, garlic, and onion against both bacteria and molds. The composition, structure, as well as functional groups of the oils play an important role in determining their antimicrobial activity[21,22]. Antibacterial, antifungal, and antioxidant properties and chemical compositions of essential oils obtained from cinnamon, y lang-y lang, basil, lemon, lemon grass, frankincense, marjoram, and rosemary were reported by Baratta et al. (1998).

Antifungal activity of essential oils

The highest antifungal activity is demonstrated by phenolic compounds such as carvacrol, thymol and eugenol. Another effective group of active compounds are alcohols: terpinen4-ol, „-terpineol, geraniol, cytronellol, menthol and linalol. Many of them are synthesized by plants from the *Lamiaceae* family[23]. For instance, the essential oil of *Satureja hortensis* L. demonstrates high levels of activity.

The compounds containing phenolic groups are usually most effective[7,24]. The components present in essential oils like these have been known to possess antimicrobial activity and some are classified as Generally Recognised As Safe (GRAS) substances and therefore can be used to prevent post-harvest growth of native and contaminant bacteria. The essential oil fractions sensitise the cell membrane, causing an increase in permeability and leakage of vital intracellular constituents, as well as the impairment of bacterial enzyme system and cell respiration[13,25].

Application of essential oils in other bases

A number of studies show that essential oils and their constituents possess useful properties concerning human health. Many of them may be applied in anticancer therapy, cardiovascular and nervous system disorders to reduce the level of cholesterol, to regulate the glucose level or to stimulate hormone production[26]. They also might have great value in preventing and treating infectious diseases. Their multiple antibacterial, antifungal, antiviral and also anti-inflammatory and antioxidant effects, have made them valuable agents in human treatment and for the prevention of pathological changes. In addition, essential oils have a number of beneficial properties as natural preservatives in cosmetics, toiletries, drugs and food products[27,28,29]. Considering the huge increase in the number of multidrug resistant bacterial strains in health care facilities, essential oils may prove to be effective natural antimicrobial agents.

Compounds of some essential oils

Monoterpene hydrocarbons such as thymol, eugenol, or carvacrol may inactivate the essential enzymes, react with the cell membrane activity, or disturb the genetic material functionality, energy production, and structural components synthesis[30]. The most abundant components in thyme essential oil are carvacrol 58.1%, linalool 15.4% and,,-terpinene 5.2%, while the minor components are p-cymene, thymol, caryophyllene, ·-terpineol, mycene, and ·-terpinene. The most abundant components in sage, myrtle, and laurel essential oils are 1ñ8 cineole (38.6; 24.8; 56.7%), ·-pinene (7.0; 23.5; 4.9%), and limonene (0; 0; 14.2%). Smaller amounts were found of ·-terpineol, ,-pinene, ,-caryophyllene, myrcene, caphure, ·-thujone, camphene, ·-humulene, and ,-thujone in sage essential oil; linalool, mirtenyl acetate, ·terpineol, nerol, linoleicacetate, geranilacetate, is obutanoate, carvacrol, and geraniol in that of myrtle; ·-terpineol, sabinene, ,-pinene, terpinen-4-ol,p-cymene, trans pinocarveol, and ,,-terpinene in that of laurel. The principle component detected in orange essential oil is limonene 84%. This oil also contains sabinene 4.2% and smaller levels of p-cymene and mycene.

It was reported that the bactericidal properties and antibiotic activity of thyme essential oil are supposed to be associated with high levels of carvacrol and linalool[20,31]. Moreover the genus Thymus comprises numerous species and varieties whose essential oil compositions have been studied. This species also contains linalool, ,-pinene, ·-terpineol, camphor, borneol, and thymol[19,32,33]. Thyme essential oil contains 43% thymol and 36%p-cymene was reported.

It can be said that, the percentages of these compounds varied slightly across different collection periods, numerous species, varieties, and geographical regions[14,19].

Activation of essential oils to control of fungal in food industry

Previous research into the essential oils has remarkably increased, mainly with regard to the antimicrobials used to control food pathogens and native microflora[13,14,16,34] and to the know- ledge of the possible mechanism of the action of plant essential oils[25].

According to some results, the antimicrobial of the most of essential oils like thyme, sage, myrtle, and orange, showed a moderate inhibitory activity against the molds. In particular, the oils of thyme and sage showed very good effectiveness and the widest activity spectrum, and molds were showed a strong resistance against laurel oil. Although the antifungal activity of essential oils has been reported several times, its activity against food-spoilage and pathogen yeast was scarcely investigated. At the same time, the different performances of fered by essential oil scan be also related to essentially different chemical compositions and other factors such as biological properties, geographical regions, etc. As previously reported, yeasts and fungi are markedly inhibited by oils rich in phenolics, aldehydes, and alcohols[14,36].

DISCUSSION

The greater antifungal potential of some essential oils could be explained by the presence of carvone, which possesses very strong antifungal activity[37,38]. For instance the essential oil of *M. piperita* possesses menthol and 1, 8-cineole as main components, which also exhibited very good antifungal properties but lower than carvone. Carvone has better antifungal properties because of its high water solubility. One of the reasons for lower antifungal activity of *M. piperita* essential oil could be the large amount of menthyl acetate, which causes a decrease of antifungal properties[39].

Previous results of investigation of antifungal properties had shown that hydrocarbon monoterpenes had the lowest antifungal activity, larger

Antifungal potential could be due to the presence of oxygenated terpenes or of those with phenolic structures[37,38,40,41]. The hydrocarbons tend to be relatively inactive regardless of their structural type, and this inactivity is closely related to their limited hydrogen binding capacity and water solubility[6]. Ketones, aldehydes and alcohols showed activity but with differing specificity and levels of activity, which is in connection with the functional groups present but also associated with hydrogen-binding parameters in all cases.

CONCLUSION

The results revealed the potential of some oils, such as those of clove, thyme, sage, laurel, sweet, onions, garlic, etc. as natural preservatives in food technology, and pointed out the potential application of plant species and essential oils of them as antifungal, and also the need to use extended concentrations of them in food systems such as cheeses with high moisture. The essential oils of some plants e.g., *T. vulgaris*, *T. tosevii* and of *M. piperita* and *M. spicata* are highly active as fungi toxicants and could safely be used as natural preservatives to replace synthetic fungicides in the prevention in some foods specially UF feta cheeses.

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