European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 06, Issue 01, 2019

Utilization of Cloves, Mentha, Cinnamon, Fennel and other Volatile Oils in Quick Remedies of cases of Nasal Congestion

KOMAL CHANDRA,

Department of Pharmacy, Graphic Era Hill University,
Dehradun, Uttarakhand, India 248002

Abstract

The emergence of multidrug-resistant bacteria and the subsequent growth in antibiotic resistance have made it imperative that new therapies and alternate treatments for infections be constantly developed. Essential oils (EOs) are widely used in the cosmetics, healthcare, traditional medicine, and food industries, therefore investigating their antibacterial properties could be one solution to this worldwide issue. Because of their varied chemical composition, the mechanism of action of EOs is complex. Respiratory tract diseases (RTDs) are bacterial infections and inflammation of the respiratory tract, and they can affect people of any age. Because of their low volatility, EOs can be inhaled directly into the lungs. They can help cure respiratory tract infections (RTIs) since they are antibacterial and anti-inflammatory. The goals of this review are to look at the most common respiratory diseases (both upper and lower) and to demonstrate how to test an EO's antibacterial activity by gaseous contact. We also talk about how EOs can reduce inflammation and how they affect bacterial cells. Results from ongoing human and animal trials are also presented. Also shown are patents that cover the management of RTIs by the use of EOs and their volatile components. The overarching purpose of this review was to demonstrate that EOs are useful in the treatment of RTDs, including RTIs, as antibacterial and anti-inflammatory drugs.

This review aims to do two main things: (1) outline the most frequent disorders affecting the respiratory system, and (2) show that EOs have antibacterial effect in the vapour phase. Essential oils' anti-inflammatory and anti-bacterial properties are also covered. Human and animal research in real life are also included. Some volatile components of EOs have been shown to be effective in treating respiratory disorders, and this topic is the subject of a number of recently released patents.

Keywords: antimicrobial activity, respiratory tract infections, essential oil, vapour phase, human trial, patent

Introduction:

In an effort to find new antibiotics, various research organisations have concentrated their efforts on examining the antibacterial properties of plants and their extracts due to the rise in multidrug-resistant bacteria and the corresponding rise in antibiotic resistance to them. As a result, investigations on the in vitro antibacterial activity of EOs have been conducted in an alarmingly large number, frequently with no fresh ideas. The oxygenated terpenoids included in EOs, such as alcohols, aldehydes, esters, ketones, peroxides, and phenols, have been proven to be responsible for the EOs' potent antibacterial properties and capacity to inhibit bacterial growth. "Studies on the antimicrobial activity of EOs in vitro

describe a variety of assays, such as disc diffusion, agar diffusion, broth dilution, etc., with different parameters (bacterial or fungal strains, agar recipes, incubation time, solvents, etc.), making it difficult to compare the outcomes of the various studies". Their trustworthiness is typically questioned. There are potentially hundreds of chemical constituents in essential oils (EOs), including volatile compounds like mono- and sesquiterpenoids, phenylpropanoids, etc., that may have biological function. Compression, enfleurage, solvents, and distillation (water steam or hydrodistillation) are all viable methods for removing these compounds from the specialised cells, secretion ducts or cavities, or glandular hairs where they are produced. Among the several methods available for analysing EOs, gas chromatography-mass spectrometry (CG-MS) is the gold standard. It is generally accepted that the biological activity of EO is determined by its composition, which in turn is affected by a wide variety of variables such as environmental circumstances, soil type, plant parts, chemotypes of plant species, isolation procedures, etc.

Since EOs are highly volatile and not water soluble, conventional screening procedures (such as disc diffusion or agar absorption) cannot be used to accurately evaluate their antibacterial capabilities. To determine whether or whether EOs have antibacterial properties, Hood et al.4 compared the efficacy of several methods. The researchers found that only the more water-soluble components could permeate the agar media using the disc diffusion method, indicating that the method did not produce trustworthy results. Even while diluting essential oils in broth is a valid technique, it's important to watch how much Tween you use because it could affect bacterial growth and cell permeability. Tween may either inhibit or enhance the antibacterial effects of EO, depending on their respective interactions. In order to provide replicable results with EO bactericidal activity, it is crucial to tailor the parameters of our technique before beginning research.

Worldwide, lower respiratory tract infections (LRTI) account for 5% (3.1 million deaths) of all deaths in both sexes, according to data from the World Health Organisation (WHO). There were 6% more women than men impacted by this number. Pneumonia was the cause of death for 13% of post-neonatal (1-59 month) infants in 2012. Over the past decade, LRTIs and COPD have remained the two leading causes of death, as reported by the World Health Organisation (WHO). However, many individuals still get respiratory tract infections (RTIs) like influenza, pneumonia, or tuberculosis, which can be fatal if not treated. This is despite WHO's well-organized worldwide vaccine action plan against the great majority of bacteria or viruses that cause RTIs. Possible preventative function for EOs in the treatment of RTIs. Because of their volatility, EOs can be used topically, but it appears that inhalation is the most effective method of transport (Harris, 2010).

In this study, we provide a brief synopsis of upper and lower respiratory tract infections, with an emphasis on the most common illnesses seen by patients. The vapour phase test (VPT) is an in vitro procedure that may help establish if volatile compounds in the airways have antibacterial effect. Consequently, this assessment will take VPT into account. In addition, we will discuss the benefits of EOs as antibacterial and anti-inflammatory agents. Additionally, we highlight recent in vivo investigations and clinical trials in humans. New patents have been issued that propose treating RTDs with EOs or their volatile derivatives.

Essential oils in the treatment of respiratory tract infections

The European Pharmacopoeia officially acknowledges over 25 different essential oils. A number of essential oils, including those from anise, bitter fennel fruit, eucalyptus, peppermint, tea tree, and thyme, are commonly used to treat ailments of the respiratory system. These oils have been used for a long time and have been given a general OK by the HMPC in their Community Herbal Monographs. In this part, we'll offer you a quick rundown of these essential oils.

(i) Anise oil: Steam distillation is used to extract anise oil (Anisi aetheroleum) from the dried, ripe fruits of Pimpinella anisum L. and star anise oil from Illicium verum Hook. Anise oils are transparent, colourless, or light yellow liquids. Because of their trans-anethole concentration, they can jellify at 14–16 °C. The essential oil in the fruits ranges from 2–6%. Trans-anethole (80–95%), anisaldehyde, and trans-anethole and methyl-cavicol are the principal components of anise oil.

Anise oil can be used to treat respiratory issues, primarily as an expectorant in coughs brought on by colds. A single dose of anise oil is 50–200 L, taken three times each day, although it shouldn't be taken for longer than two weeks. Due to a lack of data and the inclusion of estragole, it is not recommended for usage in children and adolescents under the age of 18. Anise and its oil should not be consumed by people who are known to be sensitive to anethole (Dhar, 1995). Due to anethole's moderate oestrogenic action and its effects on infertility in rats, preparations containing it should not be used during pregnancy or breastfeeding (Dhar, 1995). Although their frequency is unknown, allergic reactions that affect the skin or the respiratory system may happen.

(ii) **Bitter fennel fruit oil:** The ripe fruits of Foeniculum vulgare Miller, ssp. vulgare var. vulgare, are steam-distilled to produce bitter fennel fruit oil (Foeniculi amari fructus aetheroleum). The EO is a liquid that is transparent, colourless or pale yellow and has a distinct aroma. Fenchone (12.0–25.0%) and trans-anethole (55.0–75.0%) make up the majority of the oil's chemical composition.[17]

Bitter fennel fruit oil is a traditional herbal remedy used to treat coughs brought on by colds. Adults and senior citizens can take 200 L of EO for no longer than two weeks, either as a single dose per day or in several evenly spaced doses. Because there is a paucity of information and estragole is present, it should not be used in children or teenagers under the age of (Dhar, 1995). The active ingredient (like trans-anethole) may cause hypersensitivity to manifest. Excessive amounts of fennel oil may have an impact on hormone therapy, the oral contraceptive pill, and hormone replacement therapy due to the oestrogenic activity of trans-anethole. It's possible that fennel oil will cause allergic reactions that impact the respiratory system, although how frequently this happens is unknown (Burt, 2004).

(iii) Eucalyptus oil: By steam distillation and rectification, the 1,8-cineole-rich fresh leaves or terminal branchlets of many eucalyptus species yield eucalyptus oil (Eucalypti aetheroleum). The three species of Eucalyptus most commonly utilised are E. globulus Labill., E. polybractea R.T. Baker, and E. smithii R.T. Baker. This oil has an aromatic and camphoraceous smell and flavour, and it is colourless or pale yellow in liquid form. The plants' essential

oil concentration ranges from 0.5 to 3.5%, with 1,8-cineole accounting for at least 70% of the total. Other minor components include -pinene (2–8%) and camphor (less than 0.1%). The oil obtained from initial steam distillation is corrected by alkaline treatment and fractional distillation in order to attain these specifications and to minimise less desired components like aldehydes.

Eucalyptus oil is mostly used to treat cough, colds, bronchitis, and to relieve the symptoms of upper respiratory tract catarrh and colds. A 1.5% V/V solution made from 1 tablespoon (15 ml) per litre of warm water or 12 drops per 150 ml of boiling water can be used for inhalation, and the treatment can be repeated up to three times per day. Ointments containing 1.3% V/m oil and eucalyptus oil are prescribed for adults and children over the age of 12 to be applied as a thick layer up to three times per day. Applying eucalyptus oil or its preparations to a baby's or young child's face, particularly the nose, is not advised.

(iv) Peppermint oil: Peppermint oil (Menthae piperitae aetheroleum) is made by steam distilling the fresh tops of the flowering plant Mentha piperita L. The EO is a clear, pale yellow or pale greenish-yellow liquid. It has a distinct smell and taste, and then it feels cold. "Peppermint contains menthol (30–55%), menthon (14–32%), isomenthone (1.5–10%), menthyl acetate (2.8–10%), menthofuran (1–9%), 1,8-cineole (3.5–14%), limonene (1–5%), no more than 3% pulegone and no more than 1% carvone, with a higher ratio of cineole to limonene". Peppermint oil can be used to treat stomach problems like flatulence and irritable bowel syndrome, as well as coughs and colds. When 3–4 drops of oil are added to hot water, the mixture can be inhaled. Because menthol can cause reaction apnea and laryngospasm, peppermint oil should not be used on children younger than 2 years old (Burt, 2004). Because of the risk of laryngeal and bronchial spasms, peppermint oil products should not be put directly on the nose or chest of babies and young children. People who are prone to it can stop breathing and have trouble breathing if they breathe in menthol. Due to a lack of glucose-6-phosphate dehydrogenase, menthol can cause jaundice in newborn babies. Because there isn't enough proof, peppermint oil shouldn't be used during pregnancy without a doctor's advice.

(v) Tee tree oil: Tea tree essential oil (Melaleucae aetheroleum) is made by steam distilling the leaves and branch tips of Melaleuca alternifolia (Maiden and Betch) Cheel, M. linariifolia Smith, M. dissitiflora F. Mueller, and/or other Melaleuca species. It has a distinct smell and is a clear, white to pale yellow liquid.17 Plants have about 2% EO, most of which is made up of monoterpenes like terpinen-4-ol (at least 30%), -terpinene (10–28%), and 1,8-cineole (less than 15%).

Tea tree oil can be used to treat respiratory illnesses like the common cold, influenza, and bronchitis. For external use, you can use liquid or semi-solid mixtures with 5–10% m/m tea tree oil. Contact dermatitis happens seldom. Tea tree oil shouldn't be used during pregnancy because there's no evidence that it's safe (Tripathi and Dubey, 2004).

(vi) Thyme oil: "Thyme oil (Thymi aetheroleum) is made by steam distilling the fresh flowering upper parts of Thymus vulgaris L., T. zygis Loefl. ex L., or a

mixture of both species. It is a clear, yellow or very dark reddish-brown liquid that smells like thymol and is either yellow or very dark reddish-brown. The dried herb has as much as 2.5% EO in it". The phenols and terpenoids in thyme oil are mostly thymol and/or carvacrol.

Thyme oil can be used to treat things like lung problems (like bronchial catarrh and to help treat pertussis). Four or five drops of thyme oil can be used to breathe in. Thyme oil shouldn't be used by people under 5 years old, people with epilepsy or thyroid problems, or women who are pregnant.

Antimicrobial activity of essential oils in terms of gaseous content: It has been extensively researched and proven that EOs have antibacterial action in vitro against a variety of pathogens, typically employing disc diffusion or agar dilution methods as a direct-contact assay. The assay findings are difficult to compare to one another because these procedures utilised various parameters (such as microbe strains, agar recipes, incubation durations, etc.) that were frequently used without any advances. As a result, the reliability of the assays is occasionally called into doubt. It should be remembered that as EOs are non-water soluble compounds, standard screening techniques like disc diffusion and agar absorption might not be suitable for evaluating their antibacterial properties.

Traditionally, EOs have been inhaled to treat respiratory tract infections (Federspil, Wulkow, Zimmermann, 1997). The vapour phase test (VPT), among in vitro techniques, best illustrates the vapour activity of EOs, and these findings may be helpful to comprehend their antibacterial action in the respiratory tract. In VPT, "the upper lid of a Petri dish is often lined with a paper disc containing EO. Agar is present in the lower lid, and it is covered with a suspension of the test microorganism that has around 106 cfu/mL. To stop vapour leakage, the plate is instantly flipped onto the lid and parafilm is used to seal it. The indicator of EO activity is the ability to identify a suppression of bacterial growth on the agar plate after incubation. Because only a few publications define the minimum inhibitory concentration (MIC) in atmosphere (MICair) by using airtight boxes, this method only yields relative values (Tyagi and Malik, 2010)".

Only a small number of articles evaluated respiratory tract pathogens. Inouye et al.(2001) evaluated the effectiveness of EOs and their primary constituents against H. influenzae, S. pneumoniae, S. pyogenes, and S. aureus in the gaseous form. The EOs containing terpene alcohols were followed by "the oils of cinnamon bark, lemongrass, and thyme (wild, red, and geraniol types), which displayed the lowest minimal inhibitory doses (MID, mg/L in air). High MIDs were found in EOs high in ketone, ether, and hydrocarbon. The scientists came to the additional conclusion that EOs' antibacterial action was most potent in conditions of high vapour concentration and brief exposure time. The most delicate strains were H. influenzae, S. pneumoniae, S. pyogenes, and S. aureus. Cinnamaldehyde and thymol, two of the primary components of EO, had the highest activity (6.25 mg/L in air); they were followed by citral, perillaldehyde, octanal, and nonanal. While esters (geranyl and linalyl acetate) had very little effect on S. aureus (800 mg/L in air), menthol, terpinen-4-ol, and linalool did".

Prophylactic Action of Airborne Vectors: Alvarenga et al. (2014) studied the effectiveness of Eucalyptus citriodora EO as an anti-tuberculosis agent when diffused into the air. Methods such as GC-MS, biochemometrics, high-resolution CCC fractionation, and chemometric analysis were

employed here. The anti-tuberculosis activity was evaluated using the inverted Petri dish technique. Citronellol, linalool, isopulegol, terpineol, spatulenol, and eudesmol were identified in the EO of E. citriodora by Kiemholz (1959). Using the artificial mixtures (AMxs) technique, it was demonstrated how the EO components interacted with one another. While citronellol, citronellal, and eucalyptol (the AMxs) were beneficial against tuberculosis, citronellal, the major component of E. citriodora oil, showed only moderate activity on its own. The authors emphasised the need to consider the potential for major and minor phytoconstituents to have additive and synergistic effects.

Mode of antibacterial and anti inflammatory actions of EOs: While our knowledge of how EOs fight diseases is expanding, S. aureus has been utilised extensively as a test organism. The effects of Santolina corsica and Inula graveolens EOs on the S. aureus ATCC 6538P strain were investigated in one study.39 Time-kill and bacterial lysis tests were conducted to determine the impact of treatment duration and concentration on cell viability. Using transmission electron microscopy, the structural modifications induced by the EO treatments were seen. The researchers speculate that the cytoplasmic membrane and the cell wall have a role in the toxic effects of I. graveolens and S. corsica EOs. Terpene-free cold-pressed Valencia orange (CPVO) EO was tested for antibacterial activity and mechanism of action in a study on methicillin-resistant Staphylococcus aureus (MRSA) by Muthaiyan et al. The results showed that the inhibition of cell wall formation and triggered cell lysis seen with transmission electron microscopy was comparable to the 0.1% of CPVO oil-generated cell wall stress stimuli. Since EOs can alter the structure of the cell membrane, they indirectly affect the production of certain bacteria's toxin.

Airway inflammation, airway hyperreactivity, mucus secretion, and cough are all symptoms of several respiratory diseases. A review paper by Banner et al. (2011) compiled evidence to suggest that modulating a subset of TRP channels may be effective in treating these symptoms. They concluded that there are still many pharmacological and physiological concerns that need answering, despite the significant and rapid advances in our understanding of TRP channels in recent years. They hypothesised that if selective TRP channel blockers were used in clinical practise, it would usher in an exciting new era in the study of TRP channel modulators as potential therapeutics. EOs, with all their constituents, appear to be able to target many different types of cells.

Conclusion

Essential oils can be made up of many different chemical compounds, including but not limited to mono- and sesquiterpenoids and phenylpropanoids. They can be taken internally (like peppermint oil) or used topically (like rosemary oil) for medical purposes. Another example would be eucalyptus oil. Oils heavy in phenols, including thyme and clove, can kill microorganisms. Materials with these effects can be useful in the treatment of a wide range of respiratory tract illnesses, since they have antibacterial, antiviral, anti-inflammatory, mucolytic, bronchodilator, and other effects.

EOs' antibacterial activity can be tested in vitro using a variety of techniques. These days, in vivo animal models of respiratory tract illnesses offer important chances to investigate their diverse biological effects. It is crucial to remember that there are still just a few meticulously organised human experiments. Several studies also have some limitations. First of all, data with a small sample size could be more difficult to interpret. Second, analysing the data over short time periods

(such as three days) is inadequate. There is also another limitation on the safe usage of EOs. To determine whether utilising EO formulas is safe, more extensive research should be planned, yet under some conditions, no significant negative effects were found. A double-blind trial involving EO or any of its component elements is very difficult to conduct. There is no doubt that more research, mainly in human trials, is necessary to better understand the tolerance and efficacy of EOs in respiratory tract disorders. More trials are required since it's possible that data from human study can generate novel ideas for new patents and perspectives on how to build products.

References

1. Can Baser K. H., Buchbauer G.. *Handbook of Essential Oils. Science, Technology, and Application*. CRC Press, Taylor & Francis Group: New York, 2010.
2. Stefanello M. E. A., Pascoal A. C. R. F., Salvador M. J.. *Chem. Biodivers.* 2011, 8, 73.
3. Solórzano-Santos F., Miranda-Novales M. G.. *Curr. Opin. Biotechnol.* 2012, 23, 136.
4. Hood J. R., Wilkinson J. M., Cavanagh H. M. A.. *J. Essent. Oil Res.* 2003, 15, 428.
8. Harris B.. In *Handbook of Essential Oils. Science, Technology, and Application*, Can Baser K. H., Buchbauer G. (eds). CRC Press, Taylor & Francis Group: New York, 2010; 315–351.
9. Forbes B. A., Sahm D. F., Weissfeld A. S.. *Bailey and Scott's Diagnostic Microbiology*, 12th edn Mosby Elsevier: St. Louis, 2007.
10. Deák J.. In *Az orvosi mikrobiológia tankönyve*, T. Pál (eds). Medicina: Budapest, 2012; 485–492.
11. Poe R.. *Guthrie J.* 1996, 65, 40.
13. Salemi C., Morgan J., Padilla S., Morrissey R.. *Am. J. Infect. Control* 1995, 23, 188.
14. Caroll K. A.. *J. Clin. Microbiol.* 2002, 40, 3115.
21. Dhar S. K.. *Indian J. Physiol. Pharmacol.* 1995, 39, 63. 3. EMA Community Herbal Monographs: Peppermint oil
24. Burt S.. *Int. J. Food Microbiol.* 2004, 94, 223.
25. Tripathi P., Dubey N. K.. *Postharvest Biol. Technol.* 2004, 32, 235.
26. Celik A., Aydinlik N., Arslan I.. *Chem. Biodivers.* 2011, 8, 454.
27. Stamenic M., Vulic J., Djilas S., Misic D., Tadic V., Petrovic S., Zizonic I.. *Food Chem.* 2014, 165, 307.
28. Buru A. S., Pichika M. R., Neela V., Mohandas K.. *J. Ethnopharmacol.* 2014, 153, 587.
29. Federspil P., Wulkow R., Zimmermann T.. *Laryngo Rhino Otol.* 1997, 76, 23.
30. Tyagi A. K., Malik A.. *BMC Complement. Altern. Med.* 2010, 10, 65.
31. Maruzzella J. C., Balter J., Katz A.. *Am Perfumer Aromatics* 1959, 74, 21.
32. Kiemholz M.. *Arzneim.-Forsch.* 1959, 9, 519.
33. Kloucek P., Smid J., Frankova A., Kokoska L., Valterova I., Pavela R.. *Food Res. Int.* 2012, 47, 161.
34. Doran A. L., Morden W. E., Dunn K., Jones E.. *Lett. Appl. Microbiol.* 2009, 48, 387.
35. Inouye S., Takizawa T., Yamaguchi H.. *J. Antimicrob. Chemother.* 2001, 47, 565.
36. Al Yousef S. A.. *Egypt. Acad. J. Biol. Sci.* 2014, 6, 37.
37. Alvarenga R. F. R., Wan B., Inui T., Franzblau S. G., Pauli G. F., Jaki B. U.. *J. Nat. Prod.* 2014, 77, 603.

38. Usachev E. V., Pyankov O. V., Usacheva O. V., Agranovski I. E.. *J. Aerosol Sci.* 2013, 59, 22.
39. Guinoiseau E., Luciani A., Rossi P. G., Quilichini Y., Ternengo S., Bradesi P., Berti L.. *Eur. J. Clin. Microbiol. Infect. Dis.* 2010, 29, 873.
40. Muthaiyan A., Martin E. M., Natesan S., Crandall P. G., Wilkinson B. J., Ricke S. C.. *J. Appl. Microbiol.* 2012, 112, 1020.
41. Faleiro M. L., Miguel M. G.. *In Fighting Multidrug Resistance with Herbal Extracts, Essential Oils and their Components*, Rai M. K., Kon K. V. (eds). Elsevier: USA, 2013; 65–94
42. Nazzaro F., Fratianni F., De Martino L., Coppola R., De Feo V.. *Pharm* 2013, 6, 1451.
43. Bouhdid S., Abrinin J., Amensour M., Zhri A., Espuny M. J., Manresa A.. *J. Appl. Microbiol.* 2010, 109, 1139.
44. Felső P., Horváth Gy., Bencsik T., Godányi R., Lemberkovics É., Böszörményi A., Böddi K., Takátsy A., Molnár P., Kocsis B.. *Flavour Fragance J.* 2013, 28, 367.
45. Burt S. A., van der Zee R., Koets A. P., De Graaff A. M., van Knapen F., Gaastra W., Haagsmann H. P., Veldhuizen E. J. A.. *Appl. Environ. Microbiol.* 2007, 73, 4484.
46. Mulyaningsih S., Sporer F., Reichling J., Wink M.. *Pharm. Biol.* 2011, 49, 893.
47. Orhan I. E., Ozcelik B., Kan Y., Kartal M.. *J. Food Sci.* 2011, 76, 538.
48. Orafidiya L. O.. *Phytother. Res.* 1993, 7, 269.
49. Grosjean D., Williams E. L. II, Seinfeld J. H.. *Environ. Sci. Technol.* 1992, 26, 1526.
50. Banner K. H., Igney F., Poll C.. *Pharmacol. Ther.* 2011, 130, 371.