



Aromatherapy: overview, safety and quality issues

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Abstract

Introduction

Aromatherapy is a popular complementary and alternative therapy that uses essential oils as the main therapeutic agent. Essential oils are complex phytochemicals with a wide range of actions and clinical applications. They have a long history of traditional use and growing evidence base. This article discusses the definition of aromatherapy, outlines the main aromatherapy practice models and the safety and quality issues associated with using essential oils in health care.

Conclusion

Essential oils can be a useful non-medicinal option or combined with conventional care for some health conditions, provided safety and quality issues are considered.

Introduction

Aromatherapy, a form of phytotherapy or botanical medicine, uses essential oils (EOs) as therapeutic agents. EOs have a long history of traditional use, including military hospitals in World Wars I and II. Gattéfosse, a French chemist, is credited with coining the term 'aromatherapy' after he burned his hands in a laboratory explosion. He immediately immersed his hands in a vat of lavender EO, which reduced the pain. His hands subsequently healed without scarring or infection. The aim of this review is to discuss the general safety and quality issues of aromatherapy.

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Discussion

The author has referenced some of its own studies in this review. The protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed.

Defining Aromatherapy

Aromatherapy is a well-known but misleading term. Several definitions of aromatherapy are in common use including '... the use of odorants as inhalants to treat underlying medical or psychiatric symptoms'¹. Hirsch's definition is simple, but it does not encompass the range of application/administration methods used by the aromatherapists. Similarly, it does not differentiate between the EOs and fragrant or synthetic oils (FOs). Aromatherapists do not usually use FOs for therapeutic purposes. In this article, 'Aromatherapy' is used to refer to

The controlled use of essential oils from named botanical sources using a variety of application (external) or administration (internal) methods to suit the individual's needs to promote and support health and wellbeing using an evidence-based quality use of medicines approach².

'Controlled' encompasses:

- the quality use of EOs², which is based on the principles of Quality Use of Medicines (QUM)³ and encompasses the entire EO pathway from extraction to clinical use. QUM is an appropriate practice framework when EOs are used therapeutically.
- the qualifications and competence of practitioners
- prescribing EOs based on an accurate diagnosis following an holistic health assessment
- using the botanical name of the plant/s the EO/s was extracted from

- considering the evidence for the purpose the EO was chosen (research data and traditional use) as well as the safety and benefit for the particular individual.
- the administration/application method
- appropriately documenting the assessment and EO selection and administration processes, reporting adverse events when relevant, and a plan for monitoring the outcomes according to the aims of the treatment
- appropriately storing EOs to reduce deterioration and oxidation and meet infection control and other relevant standards
- conforming to relevant product and advertising regulatory requirements and professional standards and codes

The term 'named botanical sources' distinguishes EOs from chemically derived FOs and stresses the importance of using botanical names to distinguish among plant species because EOs from different plants have different chemical compositions, and therefore different actions. In addition, common names differ among localities and countries. EOs derived from different parts of the same plant also have different properties, thus, the part of the plant used could also be encompassed in the definition.

Aromatherapy Practice Models

There are three main aromatherapy practice models that describe how EOs are applied/administered, the doses and dose intervals and safety: medical, subtle and popular.

Medical aromatherapy

Medical aromatherapy, sometimes known as aromatic medicine and aromatology, includes internal

administration of EOs via oral, rectal and vaginal routes as well as in ointments applied in wound dressings and fumigation procedures. Only steam distilled and expressed essential oils are used internally. Internal administration is associated with more serious adverse events compared with topical and inhaled application.

Subtle aromatherapy

Subtle aromatherapy is also referred to as aromacology where EOs are predominantly administered via inhalation to influence psychological and spiritual states⁴.

Popular or traditional aromatherapy

Popular/traditional aromatherapy often encompasses touch. Touch has health benefits in its own right. EOs are applied topically in massage and in gels, creams and lotions and via inhalation for physical, psychological and spiritual effects. There are two practice subgroups: therapeutic, which is used in health care, and cosmetic or beauty therapy.

All three models use EOs as the main medicinal substance. EOs are rarely used undiluted; they are incorporated into various carrier substances depending on the application/administration route. EOs are also self-prescribed by the general public, often using self-care books and articles from the Internet that do not contain important safety and other relevant information.

Phytochemistry and Standards

EOs are extracted from the leaves, flowers, stems, fruit, seeds, bark and roots of a range of aromatic plants⁵. They contain a range of phytochemicals and their specific chemical composition depends on a range of factors such as

- the climate, growing conditions, harvest time and method
- the extraction method
- the duration of the extraction process and
- the part of the plant used.

EOs are stored in secretory structures in various parts of plants, often with resins and gums in oil cells, sacs, resin canals, ducts and hairs. EOs are extracted using several processes depending on the part of the plant, which are as follows:

- steam distillation
- expression
- enfleurage
- solvent extraction
- maceration
- fermentation
- supercritical carbon dioxide extraction⁵⁻⁷

Once the EO is extracted, the chemical composition is determined using analytical techniques such as gas chromatography, mass spectrometry, which are frequently considered together, infrared spectroscopy, optical rotation and refractive index. These tests determine whether the EO meets the composition standards. Analytical information is compiled into material safety data sheets (MDSs), which can be obtained from reputable EO suppliers. More recently, researchers have begun to investigate the peroxide value (POV) (an indicator of oxidation) of EOs and fixed vegetable oil carrier oils. POV is an indicator of the possibility an EO could cause skin irritation or sensitivity⁸⁻¹⁰.

More than 3000 phytochemicals have been identified in EOs. Phytochemicals are generally aromatic, derived from the shikimate pathway or terpenoid, derived via the deoxy-xylulose phosphate pathway¹¹. Common phytochemicals present in EOs are terpenes, sesquiterpenes, alcohols, phenols, aldehydes, ketones, esters, acids, phenolic ethers, oxides, lactones and coumarins^{12,13}. Chemotypes of plants from the same genus often have different chemical compositions and therefore actions and clinical applications. Well-known EO chemotypes occur in *Thymus vulgaris*, *Rosmarinus officinalis*, *Ocimum*, *Salvia officinalis* and *Melissa officinalis*.

It is important to know the chemical composition of an EO as well as its purity to determine how it can be used in health care (indication for use) and to estimate the safety, risks and benefits associated with particular EOs for particular individuals. EO composition standards are described by a number of bodies such as the International Standards Organisation for Standardisation (ISO)¹⁴, Research Institute for Fragrance Materials¹⁵, International Fragrance Association¹⁶, Association Francaise de Normalisation (AFNOR)¹⁷, and the British Pharmacopoeia¹⁸.

The ISO and AFNOR standards are often accepted as being the most reliable indicators of EO quality and differentiate between the different grades of EOs¹⁹. Currently, there is no standard for 'therapeutic grade EOs' (i.e., EOs used in clinical care)⁷. However, some suppliers guarantee their EOs are 100%

- pure and unadulterated. Pure EOs do not contain any synthetic substances.
- natural because they are extracted from plant materials rather than synthetic chemical substances
- complete, which means they are single distilled and have not had any chemical constituents removed or added. Ensuring an EO is complete is important to aromatherapists because they adopt a holistic person-centred philosophy where the synergistic and quenching properties of an EO are considered when deciding an EO prescription. However, some manufacturers adopt practices such as adulteration, substitution and rectification to ensure their EOs meet the required composition standard and to reduce the costs of expensive EOs such as *Rose otto* and *Jasminum officinale*.

An increasing amount of research is undertaken on isolated phytochemicals, which means the synergistic and quenching effects of the whole EO will not be considered or known.



Researching individual phytochemicals is simpler and reduces many confounding variables that enhances rigor in research but it is not consistent with the way aromatherapists use EO or the long history of traditional EO use on which most clinical applications and safety information are based.

Synergistic and quenching properties enhance the beneficial effects and reduce the undesirable effects of an EO. These beneficial interactions occur among the individual phytochemicals within an EO and/or between EOs in a blend^{6,12,20}. In most cases, aromatherapists use a blend of essential oils depending on the condition being treated. The composition of the blend is modified according to the individual's response to treatment, in much the same way herbal and conventional medicines are prescribed and monitored. Most aromatherapists do not recommend using FOs for therapeutic purposes, although they may have a role in environmental fragrancing and may have psychological effects.

Carrier Substances

In most cases, essential oils are dispersed in a substance known as a carrier. Carrier substances used for massages are usually cold pressed or fixed vegetable oils such as sweet almond, grape seed and macadamia nut oil depending on the aims of treatment. Many fixed vegetable oils such as calendula (*Calendula officinalis*) and St. John's wort (*Hypericum perforatum*) also have therapeutic properties in their own right. Other carriers include honey, *Aloe vera* and specially formulated gel and wax capsules and suppositories to which EOs are added for internal use.

EOs are hydrophobic, thus a dispersant may be required if the EOs are added to water or hydrosols to keep the EOs in solution. Interestingly, hydrophobicity enables EOs to partition with the lipid in bacterial cell membranes and mitochondria, which changes these structures and

makes them more permeable⁵. If essential molecules and ions leak from the bacteria they die. Research is currently being undertaken to determine the antibacterial properties of a range of EOs. Several studies suggest that they are more effective against gram-negative organisms^{21–23}.

Hydrosols are a by-product of EO steam distillation and contains between 0.05 and 0.02 ml of EO oil per litre. Hydrosols are used as carrier substances, prepared as tinctures, spritzers, compresses, and ingested as tonics²⁴. EOs have a range of actions including antioxidant, anti-inflammatory, antibacterial, antiviral, sedative, stimulant, analgesic, antitussive and immune-modifying^{23,25–28}.

Clinical Uses

Despite the wealth of information about what EOs are 'good for,' there is a limited amount of rigorous clinical research to support many of the claims largely due to methodological issues such as short duration, small sample sizes, invalid tools and lack of rigor relevant to the method^{27,29}. Most research into the pharmacodynamics and pharmacokinetics of EO is undertaken in animal studies often using single isolated phytochemicals or in petri dishes in the laboratory. A few studies have compared phytochemicals with conventional medicines.

Research indicates that EOs are metabolised and excreted 72–120 h after they are applied/administered depending on the

- size of the animal; however, animal studies may not directly apply to humans; although they provide important pharmacological information about EOs that is useful for determining areas for future research and can aid clinical decisions.
- chemical composition of the EO
- application/administration method
- dose and dose interval and duration of treatment. Some EOs have a cumulative effect.
- individuals' state of health

EOs are absorbed through the skin but the absorption rate of different EOs and the phytochemical composition of a particular EO varies, depending on a number of factors including the size of the individual phytochemicals. Jager et al.³⁰ detected linalool and linalyl acetate (components of lavender) in blood 5 min after a 10-min abdominal massage using 2% *Lavandula angustifolia* in peanut oil. Similarly, salicylate can be detected in subcutaneous tissue within 30 min for up to 60 min after applying 20% methyl salicylate to the forearm³¹. Bigger molecules such as the coumarins take up to an hour to penetrate³².

Research suggests some EOs can enhance the absorption of topically applied medicines. Chemical components such as limonene, 1,8-cineole and nerolidol enhance the penetration of both hydrophilic and lipophilic substances^{33–35}. Such research suggests that topical application of EOs might be contraindicated or that caution might be required if topical conventional medicines, such as anti-anginal agents, nicotine patches and hormones, are used at the same time. Alternatively, enhancing medicine absorption could be beneficial if a fast onset of action is needed.

EOs are absorbed, metabolised and excreted in a similar way to fat-soluble medicines²⁵. EOs have a short lifespan in the blood from where they are distributed to muscle and adipose tissues over a longer period. EOs may bind to plasma proteins for transportation and are largely detoxified in the liver. The exact pharmacokinetics and pharmacodynamics depend on the route of administration and the chemical composition of the EO or EO blend.

Safety

EO safety is complex. Safety data are largely based on the long history of safe traditional use, case reports and animal studies³⁶. EO safety information can be found in MDSs,

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German Commission E Monographs and ESCOP Monographs as well as from Poisons Information Centres. As indicated, composition standards are an important aspect of safety and EO risk profile.

Health professionals and the general public are advised to buy essential oils from reputable sources that label and store them appropriately for safety and medicolegal reasons. Aromatherapists and the public should be educated to read EO labels, which should contain information about

- botanical name, species, and if relevant the chemotype of the plant from which the oil was extracted or in the case of a blend, for all the EOs in the blend

- the part or parts of the plant from which the essential oil was extracted
- the names of any dispersants, incipients and preservatives
- the country where the plants were grown (country of origin)
- extraction method
- a statement of purity. However, this is not a regulatory requirement and not all suppliers make such statements.
- batch number so that the batch can be identified if an adverse event occurs to determine whether the reaction was idiosyncratic or occurred because of the manufacturing process
- expiry date
- manufacture's details

The most common adverse events are eye, mucous membrane and skin irritation and sensitisation particularly to oils containing aldehydes and phenols, and phototoxicity to EOs that contain furocoumarins, for example *Citrus bergamia*. Contact sensitisation is more likely to occur due to oxidation of monoterpenes, often due to inappropriate storage conditions^{25,37}. Cross-sensitisation to other EOs and foods is also possible. Allergy from inhaled essential oils can occur; however, data about exposure levels are limited and many of the reports concern perfumes rather than aromatherapy EOs³⁷. Cumulative effects can occur with prolonged use. EOs that are not commonly used in aromatherapy are associated with

Table 1. Potential interactions between internally administered essential oils (EOs) and conventional or herbal medicines.

Essential oil	Potential interaction/combined effect
Ylang ylang	Increases dermal absorption of 5-fluorouracil
<i>Eucalyptus globulus</i>	Enhances effects of streptomycin, isoniazid Increases nicotine absorption
Eucalyptol	Reduces the effects of phenobarbital when administered subcutaneously (in rats) and inhaled.
Roman chamomile	Products containing silver salts used in burns and wound care.
Clove, fennel, coriander, aniseed and EOs containing cinnamaldehyde, <i>trans</i> -anethole, estragole and eugenol	Deplete liver glutathione in the presence of large doses of paracetamol
Niaouli, ravensara, sweet marjoram, geranium and oils rich in terpineol	Increases absorption of topical prednisolone
Limonene occurs in many EOs	Increases absorption of indomethacin
Cedar wood	Reduces effect of barbiturates May increase the risk of coagulation by reducing the effectiveness of anticoagulants
Peppermint	Affects 5-fluorouracil cancer treatment
Myristicin (nutmeg)	Inhibits monoamine oxidase inhibitor action
β -Asarone and d-pulegone	Potentiate the toxic effect of medicines by depleting liver P ₄₅₀ enzyme system
Eugenol, menthol, oil of wintergreen and possibly white birch especially if repeated applications are used during the day.	Increases anticoagulant activity of anticoagulants and aspirin, therefore, increases bleeding risk. When applied in massage the force of the massage rather than the essential oils may represent a risk of bruising and bleeding.
Valerian	Central nervous system depressant prolongs effects and increases the risk of prolonged sleep, drowsiness and falls.
Primrose oil	Interacts with promethazines, for example chlorpromazine is used to manage schizophrenia and can induce seizures.

Interactions between topically applied essential oils and medicines are unlikely except when they are both applied to the same local site^{20,39}.

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Table 2. Issues to consider when using essential oils (EOs) in health care.

Most EOs should not be applied to the skin undiluted. Exceptions include *Lavandula angustifolia*.

People with a history of allergies and eczema can develop sensitivity to any EOs.

EOs containing aldehydes and phenols are more likely to cause allergic reactions. Patch testing before using EOs for the first time may be indicated especially in at-risk individuals.

The risk of serious adverse events is higher when EOs are administered internally.

Using the same EO or EO blend oils for long periods may lead to cumulative effects and cause sensitivity over time.

Although quality evidence to support traditional EO use is lacking, traditional precautions and contraindications concerning pregnancy and lactation, epilepsy, asthma people with alcohol or addictions and doses in certain age groups and disease states should be considered.

Use recommended traditional EO doses and dose intervals. Most aromatherapists use low doses, although effective therapeutic doses and dose ranges for specific EOs and clinical indications are unclear.

Some EOs oils are not used in aromatherapy for example wormwood, pennyroyal, rue, camphor, bitter almond and sassafras because of their known toxicity. Oil of wintergreen is sometimes included on aromatherapy EO exclusion list; however, if it is used appropriately, it is an effective analgesic in a massage blend for muscular aches and arthritic pain.

EOs must be appropriately stored to prevent oxidation and degradation and preserve their therapeutic effects and kept out of the reach of children and cognitively impaired or suicidal patients to avoid inadvertent or deliberate overdose. Vaporisers should also be placed out of reach.

EOs are highly flammable. Products must be used and disposed of appropriately to reduce the fire risk.

Educating people who self-administer/apply EOs is an important aspect of safe use. Education includes consulting appropriately qualified, reputable aromatherapists and the importance of reading EO labels.

cancer, neurotoxicity (ketones) and hepatotoxicity in large doses in animals and are most likely to occur with internal use²⁵.

Essential oil–Medicine Interactions

It is difficult to determine the interaction between conventional herbal medicine and essential oil³⁸. Only very small amounts of EOs are absorbed from topical applications, which makes interactions unlikely; however, topical application of both the EO and the medicine to the same area may enhance the absorption of medicine. The potential for interactions increases with internal use (see Table 1). Some tips to improve safe use of EOs are shown in Table 2.

Conclusion

Essential oils can be a useful non-medicinal option or combined with conventional care for some health conditions, provided safety and quality issues are considered.

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