Lavender essential oil: a review

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Abstract

Lavender essential oil is popular as a complementary medicine in its own right and as an additive to many over the counter complementary medicine and cosmetic products[1-3]. Indeed, products derived from the popular garden herb Lavender (*Lavandula* spp.) have been used for centuries as a therapeutic agent, with the more 'recent ' addition, the essential oils derived from these plants, being widely used as an antibacterial in World War I[1,4]. The oil is traditionally believed to have sedative, carminative, anti-depressive and anti-inflammatory properties, in addition to its recognised antimicrobial effects.

Many of the activities attributed to lavender oil have not, however, been substantiated in the scientific literature. This is further complicated by the fact that the majority of research into lavender essential oils has been based on oil derived from English lavender (*Lavandula angustifolia*), with little or no differentiation being made between this and other lavender essential oils. The therapeutic potential of essential oils produced from other varieties, such as *L. x intermedia* (lavandin), *L. stoechas* (French lavender) and *L. x allardii*, have largely been ignored. Although the ethnobotanical uses and major chemical constituents are similar between various lavenders, some differences do occur in both oil composition and in the reported therapeutic uses for different species[3,5]. The significant scientific interest in recent years into the validity/veracity of the traditional beliefs surrounding lavender oil and their scientific basis, if any, was recently reviewed by Cavanagh & Wilkinson[3]. In this paper we provide an overview of the use of lavender oil in infectious disease and an update on recent research on alternative uses of lavender oil.

Lavender oil (primarily *L. angustifolia*) has been found to be active against many species of bacteria, including those resistant to antibiotics such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant Enterococcus (VRE)[6-8]. Recent investigations into the antibacterial properties of a range of Lavandula oils (*L. angustifolia, L. allardii, L. x intermedia* 'Grosso', *L. x intermedia* 'Seal', *L. x intermedia* 'Miss Donnington', *L. x heterophylla* and *L. stoechas* 'Avonview') support the anecdotal use of lavender oils as antibacterial agents and demonstrated that some oils which had previously not been investigated (e.g. *L. heterophylla*) displayed good antibacterial activity against a range of bacteria including *Streptococcus pyogenes, Enterobacter aerogenes, S. aureus,* MRSA, *Pseudomonas aeruginosa, Citrobacter freundii, Proteus vulgaris, Escherichia coli,* VRE, *Shigella sonnei* and *Propionibacterium acnes*[9].

Interestingly, there was considerable variability in the activity of the essential oils, with *L. angustifolia* and *L. x intermedia* oils showing the highest activity against several bacteria. However, no one oil produced the highest level of antibacterial activity against all bacteria tested, suggesting that differences in chemical composition make some oils more effective against particular bacteria. No strong correlation has been observed between percentage of major chemical components and antibacterial activity, and *P. aeruginosa* was not susceptible to any *Lavandula* oil tested[9]. These results support the anecdotal use of lavender oils as antibacterial agents and demonstrate that some oils which had previously not been investigated have good antibacterial activity.

Despite the known antibacterial activity, questions remain about the clinical utility of lavender oil. The MIC (minimum inhibitory concentration) values of lavender oil (*L. angustifolia* and *L. latifolia*) have been reported as being comparable to that of tea tree oil (0.16% against *Haemophilus influenzae*, 0.32% against *S. pyogenes* and *S. aureus* and greater than 0.32% against *E. coli*)[10]. These figures would appear to support the use of lavender oils as a prophylactic or for use in topical application for surface infection rather than for use against deep-seated infections.

Lavender oil has also been reported to be an effective antifungal agent against fungi of both medical and agricultural importance, especially in inhibition of germ-tube growth[11]. A recent study demonstrated that all *Lavandula* essential oils examined to date displayed some antifungal activity, with oils derived from *L. angustifolia* and *L. x intermedia* demonstrating the greatest effect against *Aspergillus nidulans* and *Trichophyton mentagrophytes.*

In contrast, oil derived from *L. stoechas* was particularly effective against the agricultural fungi *Leptosphaeria maculans* and *Sclerotinia sclerotiorum,* demonstrating that *Lavandula* oils have activity against fungi of both medical and agricultural importance, and suggesting that essential oils from various lavender varieties may be useful in the treatment of fungal infections[12].

The recent interest in the therapeutic use of hydrosols, however, appears unlikely to have scientific merit as no antimicrobial activity has been found to be associated with any *Lavandula* hydrosols examined by this group to date[12]. Hydrosols or

distillate waters are a by-product of steam distillation and contain variable amounts of essential oil and other plant derived components. The variation found in the activity of the different oils suggests that different oils should be targeted for different therapeutic uses. Further work is required to determine whether the *in vitro* results are realised in a clinical environment, but it is clear that not all lavenders are equal in terms of their antimicrobial properties.

Interestingly, the volatile components of Lavandula essential oils have also been found to display potent antifungal activity; however, no significant differences in activity have been reported between different *Lavandula* oil volatiles [12-15]. Vapour treatment would appear to have an advantage over solution treatment in that the microbial growth could be inhibited by a smaller amount of essential oil, while potentially also acting as a potent inhibitor of sporulation, assuming that suitable vapour concentration and treatment times can be determined. Initial studies suggest that the gaseous contact activity of the essential oils was determined mainly by the maximum vapour concentration at an early stage of incubation and that maintaining high vapour concentration for long periods of time was not necessary [15]. It should be noted, however, that the effective vapour concentrations in a clinical setting have not yet been directly related to the concentrations used routinely in aromatherapy.

The use of essential oil volatiles for therapeutic benefit is not new. Indeed, lavender oil today is used predominantly in aromatherapy or massage, and many benefits are claimed for its use in this way, including relief of the symptoms of stress and depression, in improving 'mood' and relieving anxiety [3]. Aromatherapy is thought to be therapeutically effective due to both the psychological effect of the odour and the physiological effects of the inhaled volatile compounds, where the latter effects are believed to act via the limbic system, particularly the amygdala and hippocampus. However, although inhalation of lavender oil volatiles has been reported to be capable of altering patient mood and improving sleep patterns, the true therapeutic benefit of inhalation of lavender oil remains controversial [3, 16, 17]. This may be related to the fact that many studies combine both massage and lavender oil and are unable to determine whether the benefits seen are as a result of massage or of lavender oil inhalation/absorption.

For example, a recent study investigating the use of lavender oil aromatherapy in dementia patients found no evidence that a purely olfactory form of aromatherapy led to decreased agitation in severely demented patients and suggested that cutaneous application of the essential oil may be necessary to achieve the optimum effect [18]. Similarly, although percutaneous administration of one of the main ingredients of lavender oil, (-)-linalool, led to a decrease in systolic blood pressure and skin temperature, compared to a corresponding control group receiving a placebo, no effect on subjective evaluation of well-being was noted [19].

In another study, although massages with lavender essential oil and an inert carrier oil were unable to demonstrate any significant long-term benefits in improving pain control, but anxiety or quality of life (compared to those patients who received the inert carrier oil only or no massage) and sleep scores improved significantly in both the massage and the combined massage (aromatherapy and massage) groups. These findings were accompanied by a statistically significant reduction in depression scores in the massage group, whether lavender oil was used or not [20]. Inhalation of lavender aromatherapy during radiotherapy was also found to reduce anxiety [21].

Conversely, several authors have noted an association between lavender odour, positive emotional states and therapeutic benefit [22-25]. For example, Diego *et al.* [26] found that individuals receiving lavender oil (10%) odour for 3 minutes were significantly more relaxed, had decreased anxiety scores, better moods and showed increased alpha power in their EEGs (an indication of increased drowsiness). Similarly, in a pilot study by Walsh & Wilson [27], long-stay neurology in-patients also showed increased mood scores and reduced psychological distress following aromatherapy (tea tree, rosemary and *L. angustifolia* oils), suggesting that lavender aromatherapy can improve patients' experiences in intensive care with no detrimental physical or behavioural outcomes.

Inhalation of lavender oil is also reported to be of benefit in pain relief. Lavender oil has been shown to be an effective short-term treatment for lower back pain when acupoint stimulation was followed by acupressure with aromatic lavender oil [28]. In an other recent (animal) study, it was shown that inhalation of lavender oil (*L. x intermedia* 'Grosso') for 1 hour resulted in significant analgesic activity at doses that did not produce a sedative side-effect, with the oil appearing to significantly reduce the acetic acid-writhing response in a naloxone-sensitive manner. A similar effect was found with oral (100mg/kg) administration [29].

It has been suggested, however, that, rather than having a direct analgesic effect, inhalation of lavender oil may simply elicit a more positive appraisal and subsequent positive retrospective evaluation of treatment-related pain from the patient when they report on lavender aromatherapy associated pain relief [30]. Interestingly, Barocelli *et al.* [29] also reported that oral administration of lavender oil, or its major constituents linalool or linalyl acetate, could protect animals against acute ethanol-induced gastric ulcers.

Extensive research is now being carried out worldwide to identify and isolate the chemical components of lavender oil, which will allow the identification of biologically active constituents of the oil and determination of any synergistic effects of the 'mixed' components. While it is known that the main constituents play a major role in the biological activity of lavender oil, it has also been reported that the antimicrobial activity of different types of lavender oil are not all related to these major constituents.

For example, studies investigating the relationship between biological activity and chemical composition of lavender have found no correlation between linalool or linalyl acetate content

and antibacterial or antifungal activity[7]. In addition, very little is known of any synergistic relationships which occur between the oil constituents.

There is no doubt that identification of the biologically active components of lavender oil and determination of their mechanisms of action, in isolation and in combination, will help to clarify many of the inconsistencies currently found in lavender oil research and may lead to identification of novel, effective therapeutic compounds. Indeed, one constituent of lavender oil, perillyl alcohol (POH) has recently been identified as a potential anticancer agent, which may be useful in both treatment and prevention[31, 32].

Lavender is traditionally regarded as a 'safe' oil and, although it was recently reported that lavender oil, and its major constituent linalyl acetate, are toxic to human skin cells *in vitro*, contact dermatitis to lavender oil appears to occur at only a very low frequency [33, 34]. The relevance of this *in vitro* toxicity to dermatological application of *Lavandula* oils remains unclear. Despite the apparent safety of lavender oil as a topical agent, oral administration is not recommended.

In conclusion, many more claims are made for therapeutic benefit derived from lavender oil than are reviewed in this paper; however, controversy surrounds many aspects (reviewed in Cavanagh & Wilkinson [3]). Further research is required to determine the true bioactivity of lavender oil and its constituents. Despite this lack of evidence for many claims, lavender continues to be used by the general public and clinical staff, perhaps because any potential therapeutic benefit is seen as a possible 'bonus' to the simple love of lavender.

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