Lavender Essential Oils as an Alternative Treatment for Anxiety as well as Its Effect on the Human Body

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ABSTRACT

Lavender essential oil is commonly used in aromatherapy practices and has shown potential for alleviating anxiety. Lavender oil from various breeds contain linalool, linalyl acetate, caryophyllene, 1,8-cineole and camphor compounds. The prominence of these compounds varies between each species but linalool and linalyl acetate are the most prominent ones amongst them all. Lavender plants are found in places near the Mediterranean Sea and Southern Europe which determine their component amount and how much oil they yield as well as how the oil is extracted. Some researchers have investigated the effects of lavender by using a full essential oil mixture, whereas other studies focus solely on particular terpenoids like linalool. Multiple literature reviews have been published that summarize both animal and human studies. In this paper, we include clinical studies both of aromatherapy (inhalation) and oral consumption, in the form of Silexan. Lavender does help alleviate anxiety for short durations and has shown to be beneficial for relaxation for people without anxiety.

INTRODUCTION

Aromatherapy has been studied in clinical trials as a potential alternative to traditional pharmaceuticals in the treatment of anxiety. Aromatherapy is defined as the inhalation or bodily application (as by massage) of fragrant essential oils (as from flowers and fruit) for therapeutic purposes. (*1*). According to an article about the health benefits of lavender essential oil by Cathy Wong and medically reviewed by Caitilin Kelly, MD, lavender that comes from *Lavandula angustifolia* plant is one of the most popular essential oils used in aromatherapy (*2*). In North America, between the US and Canada, the United States has the largest Aromatherapy market with shares being 42.7% of essential oil users in 2019 *(3)*. Essential oils are a class of volatile oils that give plants their characteristic odors and used especially in perfumes and flavoring, which are employed in aromatherapy and alternative medicines *(4)* Such essential oils come from plants, flowers and some fruits like: Clary Sage, Eucalyptus, Geranium, Lavender, Lemon, Roman Chamomile, Rosemary, Tea Tree and, Ylang Ylang *(5)* In addition to lavender's pleasant aroma, lavender essential oil has demonstrated antibacterial and antifungal properties *(5)*.

Lavender essential oil has shown to be beneficial for those who suffer from general anxiety disorder (GAD) and has a relaxing effect *(6,7)*. Since medieval times, lavender's medicinal properties have been explored. For instance, lavender has been used as an anticonvulsant for the prevention of epileptic fits of convulsions, antidepressant, anxiolytic and sedative that causes a calming reaction *(8)*. Seeing that lavender essential oil is a popular oil for aroma-therapeutic uses, it is wise to study and look further into its chemical properties, how it's sourced, extracted and made, and how it can affect the human body when it comes to neurological conditions such as anxiety. Therefore, this paper will summarize background information about lavender essential oils and review the latest research regarding the use of lavender essentials oils in the treatment of anxiety.

CHEMICAL COMPOSITION OF LAVENDER ESSENTIAL OIL

Lavender essential oils are mixtures primarily composed of terpenes and terpenoids. Terpenes are made up of isoprenes which are gaseous hydrocarbons that are emitted by various plants as a natural byproduct of plant metabolism *(9)*. Terpenoids are a modified class of terpenes with functional groups and oxidized methyl groups moved and removed in various positions *(10)*. Lavender oil contains monoterpenes like linalool, linalyl acetate, 1,8-cineole and camphor (Figure 1). As well as sesquiterpenes such as caryophyllene that is found in many essential oils. Linalool is a floral terpene found in 200+ plants. Linalyl acetate is an acetate ester of linalool. 1,8-cineole or Eucalyptol is cyclic ether and an anti-inflammatory. Camphor is a white volatile crystalline substance with an aromatic smell and bitter

taste *(6)*. Woronuk, et al. summarizes the common terpenoids and their frequency in three typical kinds of lavender plant: *L. angustifolia*, *L. latifolia* and Lavandin or *L. inter-media* (Table 1) *(6)*.

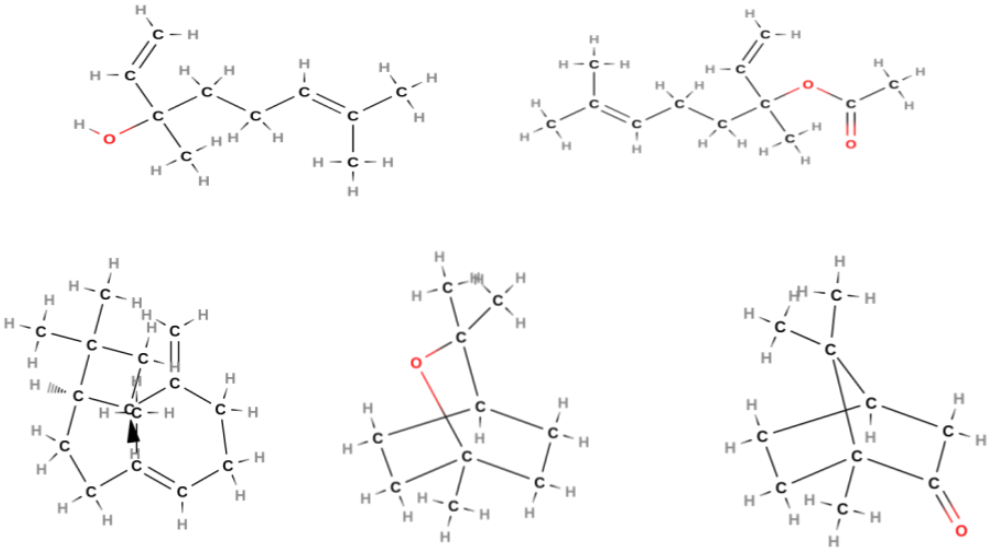


Figure 1. Several Lewis Structure of Linalool, Linalyl acetate, Caryophyllene, 1,8-Cineole and Camphor compounds.

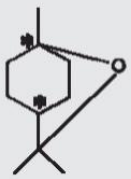
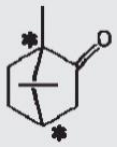
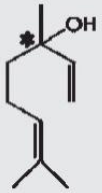
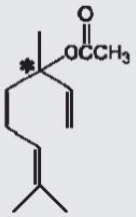
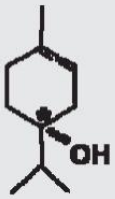
Compound	Structure	*L. angustifolia*	*L. latifolia*	*Lavandin (L. × intermedia)*
1,8-Cineole		trace	22–27	4–7
Camphor		trace	12–16	6–8
Linalool		25–38	27–41	25–35
Linalyl acetate		25–45	trace	26–38
Terpinen-4-ol		4–5%	trace	trace
β-Ocimene		3–4%	trace	trace

Table 1. The relative abundance of major essential oil constituents in typical L. angustifolia, L. latifolia, and lavandin (L. angustifolia × L. latifolia). Values are percentages of total oil yield. (*Woronuk et al*.)

SOURCE AND EXTRACTION OF LAVENDER ESSENTIAL OIL

Lavender is found near the Mediterranean Sea and Southern Europe. There are thirty species and several subspecies and hundreds of hybrids. There are 4 categories that lavender plants are placed into: L. angustifolia (English Lavender), L. stoechas (French Lavender), L. latifolia (Mediterranean Lavender). Lavender can be grown in wide ranges of climatic environments but prefers to grow in soils that drain well and have a pH range between 7 and 7.5 *(6).* It is also a xerophytic plant, a plant that has adapted to dry habitats to store water and prevent water loss *(6)*. In order for there to be a high yield of lavender oil, the woody stocks need pruned annually so the shoots of the lavender can blossom *(6).*

There are several forms of extraction of essential oils. Some extraction methods of essential oils are better than others such as: steam and water distillation. Steam distillation is a large stainless steel container, called a still, holds the plant materials that have steam vapors passing through to collect volatile compounds. The vaporized plant compounds travel to the condenser, a conversation flask. There are two pipes that have cold water entering the condenser and one with hot water exiting so that the vapors can return to a liquid state. The liquid by-products are collected in a separator. Since water and oils don't mix the oil sits on top and is siphoned off *(11).* Water distillation is similar to steam distillation instead of steam vapors extracting the oils, the plant materials are placed in water and boiled. The process after that mimics steam distillation *(11).* Solvent extraction is another option, but this method is less environmentally friendly.. This method involves hexane and ethanol, food grade solvents, to separate and isolate essential oils from plant materials *(11).* Solvent extraction also produces a finer fragrance when the plant material is treated with the solvent which produces a concrete, a waxy aromatic compound, that is mixed with alcohol to release the oil particles. Since solvent extraction involves harmful chemicals, it can cause skin irritation and residue that remains as an absolute, products that aren't essential oils that have gone through solvent extraction. As such it shouldn't be used for message purposes *(11).*

Natural fragrances are created from nature, i.e. plants and trees, but using natural fragrances can take a negative toll on the environment. Contrary to synthetic fragrances that are made in a lab. There are three types of synthetic fragrances: Full Synthetic, nearly the entire fragrance comes from petroleum byproduct, Semi Synthetic, the fragrance can be created from synthetic, natural or an artificially modified note of all three types, and Natural Isolate, a fragrance from synthetic and natural by products. Majority of essential oils aren't 100% natural. In fact they are combined with carrier oils. The only way an essential oil can be natural is if the oil from the plant was extracted without any chemicals *(12).* Both Natural fragrances (essential oils) and Synthetic fragrances have advantages and disadvantages. As far as essential oils they have the ability to help your mental and physical health and have a greater depth and character to them. Unlike synthetic fragrances, essential oils don't stick to surfaces and fabrics or leave behind residue. Essential oils can however be expensive due to the amount it takes to make 1kg of essential oils.

For example, it takes 200kg of lavender to make 1kg lavender essential oil. If essential oils are undiluted they can cause burning and irritation to the skin. On the other hand, synthetic oils and fragrances cost a fraction of the price and have a higher availability as well as a longer shelf life *(13)*. They can also duplicate the same scent as essential oils that don't irritate the skin and have a longer lasting smell. With that being said, synthetic oils/fragrances don't have the same effect as essential oils do. Other drawbacks of synthetic are as follows: using too much can have a harmful effect to the skin and respiratory system and some don't have the same natural scent. There also happens to be a labeling law that prohibits the ingredients being listed on labels of synthetic products, leaving the buyer curious as to what is actually in the product they're using *(14)*.

INTERACTIONS OF LAVENDER ESSENTIAL OIL WITH THE BODY

There are several ways to use essential oils. There is dermal absorption where you can apply diluted essential oils to the body through means or massage oils, lotions and soaps. Inhalation that is used in aromatherapy where diluted oil is used in diffusers and drops. Some essential oils are taken orally, which is safe for some if they are used for flavoring food but not if they're being taken as is; this is according to the Food and Drug Administration (FDA). Specifically, Silexan is a pill containing 36.8% linalool and 34.2% linalyl acetate, which are extracted from *Lavandula angustifolia*. Silexan is, therefore, a preparation of lavender essential oil intended for oral consumption *(7)*.

Regardless of method of exposure, lavender essential oil can enter the bloodstream, as even applications to skin results in detectable levels of linalool and linalyl acetate in blood *(14)*. Scientists are studying how lavender works at a molecular level in the body. For instance, in a study of ten healthy women using functional magnetic resonance imaging (fMRI), the odor of lavender seemed to stimulate the brain-stem, thalamus and cerebellum. It also activates the primary olfactory, the organ(s) involved in the sense of smell *(8)*. Interestingly, mice that have been bred to no longer have a sense of smell still exhibit beneficial anti-anxiety behavior following inhalation of lavender essential oil. Hence, it appears that there are ways in which lavender interacts with the body that do not involve this olfactory system *(15)*. Unlike typical anti-anxiety medications that attach to voltage dependent calcium channels (VOCCs) in the body, lavender essential oil does not seem to do the same thing; instead, there is evidence that Silexan doesn't attach to the calcium channel like the N-type, P/Q-type and T-type. Those are in a part of the brain that's associated with anxiety disorder called the hippocampus *(16)*.

While the oils that come from many plants are beneficial, it is sensible to look into the various effects of essential oils once they are administered. Essential oils are fat-soluble and volatile unlike water soluble herb extracts that are used in herbal medicine *(17)*. Essential oil can cause different reactions to the skin due to several factors. Some being temperature, humidity, when and where it was applied, the

chemical make up of each oil, skin conditions (undamaged, damaged, shaven, unshaven, suntanned or applied with protective cream) *(17).* When there are more lipid dissolving oils, the skin tends to absorb the essential oils quicker opposite to having more hydrophilic components, the absorption process will be slower *(17).* Inhaling the essential oil doesn't have as many layers to go through, it is almost a direct pathway to the lungs. This is why inhalation of essential oils is more effective than dermal and ingestion *(17).* Some components of essential oils like 1,8-cineole, from eucalyptus, are rapidly absorbed. One issue that can happen from inhalation of essential oils is that as they penetrate the blood-brain barrier, they can quickly become a narcotic *(17).*

LAVENDER ESSENTIAL OILS AS A TREATMENT FOR ANXIETY

In the past decade, several reviews have been published that summarize research studies investigating the anxiolytic (i.e. anti-anxiety) effects of lavender essential oil *(6-8),(18).* There are several anxiety disorders that are a hindrance to patients including: phobias, panic attacks, separation anxiety and general anxiety (GAD) *(7)*. Compared to males, females are twice as likely to have anxiety disorders; meaning, females make up the majority of the 10% of the adult population that have anxiety *(7)*. Some current and common anxiety medications are Lorazepam (Ativan) and Alprazolam (Xanax). These two medications are known as benzodiazepines, a psychoactive drug that is a type of tranquilizer *(19)*. Hence, lavender essential oil, which has a history of calming effects, has been pursued as an alternative treatment. These reviews were typically conducted by first performing a search of multiple databases that can consist of keywords such as L. angustifolia, lavender oil, linalool, linalyl acetate, essential oil and anxiety .

Studies reviewed by Donelli, et al. included a variety of methods of administration of lavender essential oils. Through means of inhalation, lavender oil was able to lower anxiety levels based on any valid scale to measure the levels *(20)*. However, the lavender inhalation didn't lower the systolic blood pressure as a parameter of anxiety. Silexan on the other hand, which is taken orally, was able to significantly lower the systolic blood pressure in patients with it being administered for 6 weeks at 80 mg *(20)*. Their overall conclusion is that oral administration is a far better way to indicate lavender oil's effectiveness while inhalation of lavender oil only gives slight indications to its effectiveness.

Unlike the previous discussed review, Woronuk, et al. also included animal model studies as well as human studies. Studies in mice demonstrated some sedation effects with the inhalation of linalool with or without linalyl acetate, which may parallel anti-anxiety. Woronuk reviewed numerous human clinical studies that used constituents from lavender oil. One clinical trial tested 96 undergraduate women introduced to lavender, the placebo, or to no aromatherapy at all; they were given an instructional priming procedure, such as a stimulating cognitive task to alter the expectations of the participants about the likelihood of their ability to relax due to the aroma *(21)*. The results showed that the participants were

more relaxed when they expected to relax due to the aroma but found that they were not as relaxed when they were exposed to the aroma *(21)*. In another trial, 30 men, ages 24 to 40 involved in an experiment to see how lavender aromatherapy affects coronary circulation by using a noninvasive trans-thoracic Doppler echocardiography (TTDE) to measure coronary flow velocity reserve (CFVR) at rest and while hyperemia, an excess of blood in a vessel, was happening, adenosine triphosphate (ATP), an organic compound in living cells that provides energy for psychological processes, was administered to the veins *(22)*. The participants were given 4 drops of diluted lavender oil in 20 ml of hot water that was inhaled for 30 minutes; while at the same time, a cortisol serum, the stress hormone, was administered to give a baseline. The results from the CFVR measurements showed that the volunteers' blood pressure and heart rates were not impacted by the lavender aromatherapy even with the ATP infusion. However, the cortisol serum level did lower after the volunteers were exposed to the lavender oil *(22)*. Their overall conclusion is that lavender does have a relaxing effect and may be beneficial to coronary circulation on a small scale. The human subjects studies summarized by Woronuk, et al. were limited to experiments in which lavender oil or linalool was inhaled or applied to the skin, and the authors remarked that these methods of delivery are challenging to assess and compare between studies due to missing details about dosing.

A common complaint in literature reviews is the lack of a truly controlled study because lavender has a distinct smell that is absent from placebo treatments. Therefore, it is challenging to directly study the benefits of lavender essential oil in aromatherapy because participants may be biased. However studying the effects of lavender essential oils through means of oral administration lowers the complication in trials as well as leaving little to no room for bias and error when trials are being reviewed.

The review by Malcolm and Tallian focused only on trials that involved human subjects who suffered from anxiety and these trials were all placebo-controlled, randomized, and double-blinded. Hence, these were the most rigorous studies testing the effectiveness of lavender essential oils in treating anxiety. Four out of the five trials Malcolm and Tallian recorded were from Kasper et al, experiments that tested the oral efficacy of Silexan on patients with anxiety related restlessness compared to the efficacy of lavender oil that came from the L. angustifolia breed of lavender. The patients were put into randomized, double-blinded trials where they were given 80 mg of either the Silexan or placebo once a day for ten weeks *(23)*. Patients with serious psychiatric or neurological problems were included in the experiment as well. Kasper et al used the Hamilton Anxiety Rating Scale, HAM-A, to measure severity levels of anxiety *(24)*. The HAM-A score of the group that was given Silexan decreased from 25.5±6.0 before the trial began to 13.7±7.0 after the treatment concluded. The HAM-A score for the placebo group didn't have a significant decrease. The baseline score was 26.5±6.1 and went down to 26.9±9.8. Their study showed that, even though the placebo had fair results, Silexan is a very effective anxiolytic *(23)*.

Woelk and Schläfke compared a benzodiazepine and an alternative version using lavender essential oil to see how they would treat anxiety. Silexan, the alternative medicine in review, has notably decreased anxiety levels in comparison to Lorazepam. The baseline HAM-A score for both medicines were 25±4; those who took Silexan, their score dropped to 11.3±6.7 (45%) while the Lorazepam group only dropped to 11.6±6.6 (46%). The conclusion that was reached was Silexan being just as effective as Lorazepam in adults who have GAD. Since Silexan is made from lavender oil and has no addictive or sedative qualities, it is safe to take without the risk of drug abuse *(25)*.

According to the results from the clinical trials, lavender aromatherapy, though known to be beneficial, has shown to not have the most effective results but can, to some degree, produce a calming effect for people without conditions such as anxiety for a short term effect. In the Donelli et al paper, Silexan was favorable for lowering the underlying set of conditions linked to anxiety. Thus showing that the oral administration of Silexan (oral lavender) of 80 mg is best to treat anxiety but also proving that other types of applications need further research due to them being indicators and not fully measurable.

CONCLUSION

Lavender essential oil is a beneficial supplement to treating anxiety but should not be an alternative to modern medication to treat severe cases of anxiety. However, it is helpful for those who have general anxiety. Lavender essential oil can be administered a number of ways, including inhalation through aromatherapy, dermal absorption with massage oils, as well as oral ingestion in the form of Silexan. Therefore, individuals who suffer from GAD have options for the method of treatment whether it be in the form of an oral pill that has select components of lavender oil like Silexan or by using a full mixture of lavender essential oil. More research can be done with essential oil and various routes of exposure and how scientists can better understand the biochemistry of lavender essential oil, how it specifically interacts with the body and build off of the randomized controlled trials of oral administration. This way even more rigorous aromatherapy studies in which dosing is consistent and clearly reported can be accurately reported.

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