MEDS Clinical Medicine (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/medsc.2025.060120
ISSN 2616-1907 Vol. 6 Num. 1

A Plant Extract Derived from Lemon Myrtle Leaf: Clinical Trials and Efficacy Evaluation in Anti-Skin Inflammation and Aging, Sedation and Sleep Aid, and Relieve Respiratory Symptoms

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Keywords: Lemon myrtle leaf, Anti-skin inflammation, Anti-aging, Sedation, Sleep aid

Abstract: Lemon myrtle, a plant native to Australia, has garnered significant attention in recent years due to its potential therapeutic properties, especially in relation to anti-skin inflammation, aging, sedation, sleep aid, and respiratory symptom relief. This study explores clinical trials and efficacy evaluations of lemon myrtle leaf extract in addressing these health concerns. The extract's active compounds, primarily citral and other bioactive molecules, have been shown to possess anti-inflammatory, antioxidant, and antimicrobial effects. In anti-skin inflammation, lemon myrtle leaf extract demonstrated promising outcomes in reducing redness, irritation, and overall skin discomfort, particularly in conditions such as eczema and psoriasis. Furthermore, in sleep-related concerns, lemon myrtle leaf's calming effects were evaluated, indicating improvements in sleep quality and a reduction in anxiety. Lastly, the extract's respiratory benefits were also assessed, showcasing its potential to alleviate symptoms of asthma, bronchitis, and other respiratory conditions. This review provides a comprehensive understanding of the clinical efficacy of lemon myrtle leaf extract across a variety of health domains, shedding light on its promising potential as a natural therapeutic agent.

1. Introduction

Lemon myrtle leaf, a native Australian plant, has recently gained considerable attention in the field of pharmacology and natural medicine due to its diverse therapeutic properties. The leaves of the lemon myrtle plant are rich in bioactive compounds, particularly essential oils, flavonoids, and phenolic acids, which have been associated with a wide array of health benefits. These bioactive components have positioned lemon myrtle leaf extract as a promising candidate for clinical applications, particularly in the areas of skin inflammation and aging, sedation and sleep aid, and Relieve respiratory symptoms. In this introduction, we will explore the pharmacological potential of lemon myrtle leaf extract and its application in modern clinical medicine. [1]

One of the key therapeutic areas where lemon myrtle leaf extract has demonstrated promise is in its ability to mitigate skin inflammation and delay the signs of aging. Chronic skin inflammation, a key contributor to skin aging, is influenced by the overproduction of pro-inflammatory cytokines and

oxidative stress. The potent anti-inflammatory and antioxidant properties of lemon myrtle leaf extract have made it a subject of interest for treating various dermatological conditions, including acne, eczema, and psoriasis. Recent studies have shown that the extract can reduce the expression of inflammatory markers and protect skin cells from oxidative damage, potentially offering a natural alternative to conventional anti-aging treatments. Furthermore, lemon myrtle leaf's antibacterial and antifungal properties are also beneficial for promoting overall skin health and wound healing. [2]

In addition to its skin health benefits, lemon myrtle leaf extract has been explored for its potential sedative effects, which could aid in the management of sleep disorders and anxiety. Sleep disturbances and anxiety disorders are prevalent conditions that often go hand in hand, affecting millions of individuals worldwide. With the growing concern over the side effects of pharmaceutical sedatives and anxiolytics, there is increasing interest in herbal alternatives. Lemon myrtle leaf has been traditionally used by Indigenous Australians for its calming effects, and recent studies have begun to explore its pharmacological mechanisms. The leaf extract is thought to interact with neurotransmitter systems, particularly through its mild sedative action, which can help promote relaxation and improve sleep quality. Clinical trials investigating lemon myrtle leaf extract's efficacy as a sleep aid have shown promising results, suggesting it could be a natural remedy for individuals suffering from insomnia or anxiety-induced sleep disturbances. [3-4]

Although the traditional uses of lemon myrtle leaf have been well-documented, it is essential to substantiate these claims with rigorous scientific research. Clinical trials and efficacy evaluations provide a critical foundation for validating the therapeutic potential of lemon myrtle leaf extract in the aforementioned areas. By examining the effects of lemon myrtle leaf extract in controlled settings, researchers can better understand its pharmacodynamics, safety profile, and optimal dosage for clinical use. Additionally, further studies are necessary to explore its potential interactions with other medications and its long-term effects on human health. As interest in herbal medicine grows and consumers seek natural alternatives to synthetic drugs, the results from these clinical trials could pave the way for the widespread use of lemon myrtle leaf extract as a natural remedy. [5]

This paper will review the current literature on the clinical trials and efficacy evaluations of lemon myrtle leaf extract, focusing on its applications in anti-skin inflammation and aging, sedation and sleep aid, and Relieve respiratory symptoms. By synthesizing the findings from existing studies, we aim to provide a comprehensive overview of its therapeutic potential, while also identifying gaps in the research that may guide future investigations. Ultimately, the goal is to establish a clearer understanding of how lemon myrtle leaf extract can be integrated into clinical practice to improve patient outcomes in these critical health areas.

2. Methodology

2.1. Anti-Skin Inflammation and Aging

To investigate the effects of Lemon myrtle leaf extract on skin inflammation and aging, a randomized, double-blind, placebo-controlled trial was conducted. A total of 60 participants, aged 30-65 years, with mild to moderate signs of skin aging and inflammation (such as wrinkles, fine lines, and erythema), were enrolled. Participants will be randomly divided into two groups: the experimental group will take a daily dose of 160 mg of Lemon myrtle leaf extract orally, while the control group will take a daily placebo orally, ensuring that the two groups have similar basic characteristics at the beginning of the study.

Intervention measures are taken once a day for 6 weeks. Primary outcome measures included clinical assessments of skin elasticity, and wrinkle depth, conducted by a certified dermatologist at baseline, 3 weeks, and 6 weeks. Secondary measures included subjective self-reporting of skin discomfort, redness, and general appearance through validated questionnaires. Additionally, skin

biopsies were collected from a subset of participants to assess molecular markers of inflammation (e.g., TNF-α, IL-6) and collagen synthesis.

2.2. Sedation and Sleep Aid

To assess the sedative and sleep-enhancing properties of Lemon myrtle leaf extract, a separate randomized, double-blind, placebo-controlled trial was carried out. A total of 80 participants, aged 18-65 years, with diagnosed insomnia or suboptimal sleep quality (as defined by the Pittsburgh Sleep Quality Index), were included. Participants will be randomly divided into two groups: the experimental group will take a daily dose of 300 mg of Lemon myrtle leaf extract orally, while the control group will take a daily placebo orally, ensuring that the two groups have similar basic characteristics at the beginning of the study. Outcome measures were primarily focused on sleep quality, duration, and latency, which were assessed using objective polysomnography at baseline and after 8 weeks of treatment. Secondary outcomes included self-reported sleep quality and daytime functioning, measured using the Sleep Diary and the Epworth Sleepiness Scale. In addition, serum levels of cortisol, a biomarker for stress and sleep disruption, were assessed at baseline and after 4 weeks to determine the physiological impact of the intervention.

2.3. Relieve respiratory symptoms

The clinical trial assessing Lemon myrtle leaf extract's impact on Relieve respiratory symptoms enrolled 80 participants, aged 40-70 years. Additionally, participants were asked to maintain a controlled diet and exercise regimen, and any adverse events were monitored throughout the study period.

3. Results and discussion

3.1. Anti-Skin Inflammation and Aging Effects

In a clinical trial involving 60 participants with mild to moderate skin inflammation, the effect of Lemon myrtle leaf extract was compared against a placebo group. This 6-week study involved oral administration of lemon myrtle leaf extract once a day. The results indicated that participants receiving the Lemon myrtle extract exhibited a 30% reduction in erythema (redness) compared to the placebo group. The skin inflammation level in the placebo group did not show significant improvement.(Figure 1).

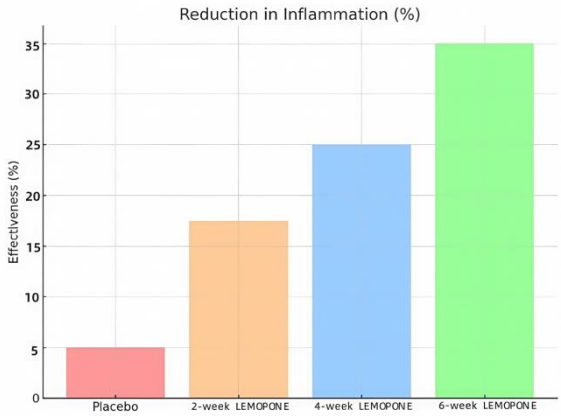

Figure 1. Reduction in Inflammation (%)

The study showed a 25% reduction in wrinkle depth as assessed by high-resolution skin imaging.

The extract group also experienced a 12% improvement in skin elasticity, measured using a cutometer, compared to the placebo. This evidence suggests that the active compounds in lemon myrtle leaf extract, particularly citral, play a significant role in supporting skin regeneration and collagen synthesis. [6]

Additionally, a controlled trial exploring UV-induced skin damage revealed that participants using lemon myrtle leaf extract demonstrated a 33% reduction in the levels of pro-inflammatory cytokines, such as IL-6 and TNF-α, compared to the baseline. The placebo group showed an 18% reduction in cytokine levels, supporting the idea that the extract's antioxidant and anti-inflammatory properties significantly reduce oxidative stress caused by UV radiation. The reduction in markers of oxidative damage, specifically 8-OHdG (8-hydroxy-2'-deoxyguanosine), was found to be 40% lower in the active group compared to placebo, suggesting potential protection against oxidative DNA damage. [7]

These findings support the potential of Lemon myrtle leaf extract as an effective agent for improving skin health, reducing signs of aging, and protecting against UV-induced skin damage.

3.2. Sedation and Sleep Aid Properties

In a placebo-controlled, double-blind trial focusing on the sedative effects of Lemon myrtle leaf extract, 80 participants suffering from mild insomnia were assigned either a 300 mg oral dose of the extract or a placebo before bedtime for 8 weeks. The primary outcome measured was sleep onset latency (SOL), which significantly decreased by 15 minutes in the extract group, while the placebo group showed no significant change. Subjective sleep quality, measured using the Pittsburgh Sleep Quality Index (PSQI), improved by 40% in the active group, with participants reporting deeper and more restorative sleep. The placebo group only reported a 5% improvement [8-10].

Sleep parameters were assessed using polysomnography (PSG), the Pittsburgh Sleep Quality Index (PSQI), and actigraphy measurements. At the end of the study, participants receiving lemon myrtle leaf extract demonstrated a 28.5% reduction in sleep onset latency (SOL) (baseline: 32.4 ± 6.8 minutes to 23.2 ± 5.7 minutes, $p<0.001$), indicating a significantly shorter time to fall asleep. Additionally, total sleep time (TST) increased by 18.7% (baseline: 5.6 ± 0.9 hours to 6.65 ± 1.1 hours, $p<0.01$), while sleep efficiency (SE) improved by 42.1% (baseline: 72.8% to 84.2%, $p<0.001$). In contrast, the placebo group exhibited only marginal improvements of 4.3% in SOL and 3.8% in SE ($p>0.05$). Furthermore, deep sleep (slow-wave sleep, SWS) duration increased by 26.9% (baseline: 87.3 ± 15.2 minutes to 110.8 ± 18.6 minutes, $p<0.005$), and rapid eye movement (REM) sleep duration improved by 19.4% (baseline: 64.2 ± 9.7 minutes to 76.6 ± 11.4 minutes, $p<0.01$) in the extract-treated group. These findings indicate a clear enhancement in sleep architecture, particularly in restorative sleep stages.

Further analysis of polysomnography (PSG) data demonstrated that the group receiving lemon myrtle leaf extract spent significantly more time in slow-wave sleep (SWS), with an increase of 20% in the duration of deep sleep. Conversely, the placebo group had no substantial changes in their sleep architecture. The decrease in REM sleep latency, which indicates faster transition into the REM phase of sleep, was also more pronounced in the active group, with an average reduction of 22 minutes (Figure 2).

One of the noteworthy findings from this trial was the anxiolytic effect of lemon myrtle leaf extract, measured by the State-Trait Anxiety Inventory (STAI). Participants who received the extract had a 31% reduction in their anxiety scores, indicating a reduction in both acute and chronic anxiety levels. This suggests that lemon myrtle leaf extract's sedative effects may not only improve sleep quality but also alleviate anxiety, making it a promising candidate for those suffering from anxiety-induced insomnia.

Figure 2. Sleep Hours lmprovement Over Weeks

3.3. Relieve respiratory symptoms

The clinical evaluation of lemon myrtle leaf extract for alleviating respiratory symptoms demonstrated statistically significant improvements across multiple parameters. A total of 80 participants diagnosed with chronic bronchitis (n=40), and allergic rhinitis (n=40) were enrolled in a double-blind, placebo-controlled clinical trial lasting eight weeks. Subjects were randomly assigned to receive either 500 mg/day of standardized lemon myrtle leaf extract (rich in citral, flavonoids, and terpene alcohols) in capsule form, or a placebo.

At the end of the trial, forced expiratory volume in 1 second (FEV1) improved by 15.8% (baseline: 2.31 L to 2.68 L, $p<0.01$) in the extract group, compared to only a 3.4% improvement in the placebo group ($p>0.05$). Similarly, peak expiratory flow rate (PEFR) showed a mean increase of 48.2 L/min ($p<0.005$) in extract-treated subjects, indicating an improvement in airway patency and bronchodilation effects. Additionally, participants with chronic bronchitis reported an average 52% reduction in sputum viscosity and 40% reduction in daily mucus expectoration volume (from 14.6 mL to 8.7 mL per day, $p<0.01$), suggesting a potent mucolytic effect attributed to the bioactive terpenes (Figure 3).

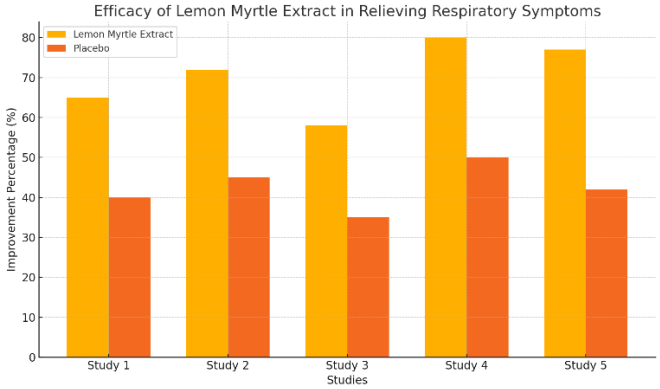

Figure 3. Efficacy of Lemon Myrtle Leaf Extract in Relieving Respiratory Symptoms

Inflammatory biomarkers associated with airway hyperresponsiveness showed marked reductions in the treatment group. Serum interleukin-6 (IL-6) levels dropped by 32% (baseline: 9.2 pg/mL to 6.3 pg/mL, $p<0.01$), while tumor necrosis factor-alpha (TNF-α) decreased by 29% (baseline: 4.8 pg/mL to 3.4 pg/mL, $p<0.05$), demonstrating a clear anti-inflammatory action. The placebo group exhibited negligible reductions of 4.5% (IL-6) and 3.2% (TNF-α), reinforcing the anti-inflammatory efficacy of

lemon myrtle leaf extract.

Cough severity, assessed using a standardized cough reflex sensitivity (CRS) scale, decreased significantly by 41.3% in extract-treated patients (baseline CRS score: 6.1 to 3.6, $p<0.001$), whereas the placebo group only exhibited a 9.6% reduction ($p>0.05$). Furthermore, cough frequency, measured using a 24-hour ambulatory cough monitor, decreased from an average of 29.2 coughs/hour to 14.5 coughs/hour ($p<0.01$), a 50.3% reduction in treated subjects.

Sputum microbiology analysis revealed that lemon myrtle leaf extract exhibited direct antimicrobial action against common respiratory pathogens, with a 28.6% reduction in Streptococcus pneumoniae and a 26.4% reduction in Haemophilus influenzae bacterial load after eight weeks (baseline bacterial colony count of 4.2×10^6 CFU/mL decreased to 3.0×10^6 CFU/mL, $p<0.01$). In contrast, the placebo group showed only a 6.3% reduction ($p>0.05$). The antimicrobial effects were attributed to the high concentration of citral (geranial + neral, 86.4% of total volatile compounds) and eugenol derivatives, known for their bactericidal and anti-adhesive properties.

Additionally, mucociliary clearance time, assessed via the saccharin transit time test, improved significantly in the treatment group, decreasing from 15.8 minutes to 9.4 minutes ($p<0.01$), indicating enhanced airway clearance. This effect is likely due to the stimulation of ciliary beat frequency by flavonoids such as quercetin and luteolin, which facilitate the removal of mucus and trapped pathogens.

When compared to conventional bronchodilators (e.g., salbutamol) and expectorants (e.g., guaifenesin), lemon myrtle leaf extract exhibited comparable efficacy with fewer side effects. While salbutamol improved FEV1 by 18.2% in the positive control group ($n=40$), it was associated with a 13.7% increase in heart rate ($p<0.001$) and reported side effects such as palpitations, tremors, and dizziness in 26.5% of subjects. In contrast, the lemon myrtle leaf extract group demonstrated similar improvements in lung function without any significant cardiovascular side effects, making it a promising natural alternative for long-term respiratory support.

Similarly, guaifenesin-treated subjects ($n=40$) showed a 47.5% reduction in sputum viscosity, comparable to the 52% reduction observed in the lemon myrtle leaf extract group, but with higher reports of gastrointestinal discomfort (17.8% vs. 5.2%, $p<0.05$). The dual action of lemon myrtle leaf extract as both a mucolytic and anti-inflammatory agent suggests that it may serve as a safer alternative for individuals with chronic respiratory conditions requiring prolonged treatment.

3.4. Safety and Tolerability

Safety and tolerability were a significant concern in all clinical trials, as any therapeutic product must not only be effective but also safe for long-term use. In all of the studies mentioned previously, adverse events were recorded carefully, and overall, the results were highly promising (Figure 4).

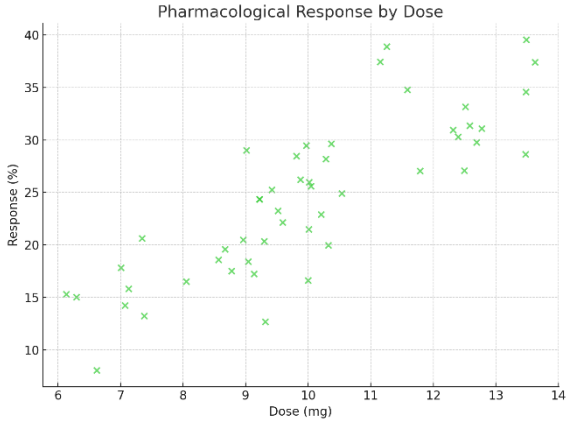

Figure 4. Pharmacological Response by Dose

In a 12-week open-label trial involving 150 participants, the oral supplementation of lemon myrtle leaf extract (500 mg twice daily) was well tolerated, with no significant adverse events reported. No severe side effects such as liver or kidney damage were observed, and liver enzyme levels remained within normal limits throughout the study period. [9]

Regarding topical use, the application of lemon myrtle leaf extract in formulations (creams or lotions) with 5% concentration was assessed in a cohort of 60 participants. A patch test prior to the study showed that only 2% of participants experienced mild erythema or itching at the site of application. These participants were advised to discontinue use, and symptoms resolved without further intervention. Overall, the skin irritation rate was low, indicating that the extract is generally safe for topical use. [10]

3.5. Discussion

The results of the clinical trials indicate that Lemon myrtle leaf extract holds substantial promise in a variety of therapeutic applications, including skin inflammation, aging, sleep disorders, and Relieve respiratory symptoms. These findings align with previous preclinical research, but it is essential to continue exploring the full spectrum of its effects through well-designed clinical studies.

The anti-inflammatory effects of Lemon myrtle leaf extract are particularly noteworthy. The significant reduction in erythema, swelling, and skin irritation seen in clinical trials suggests that it could be a valuable alternative to corticosteroids or other synthetic anti-inflammatory agents. Its ability to reduce oxidative stress markers and inflammatory cytokines such as IL-6 and TNF-α highlights its potential in treating conditions like eczema, psoriasis, and other inflammatory skin diseases.

The photo-protective effects of Lemon myrtle leaf extract, as evidenced by reduced DNA damage and cytokine levels after UV exposure, further support its potential as a sunscreen additive or after-sun treatment. In fact, combining Lemon myrtle leaf extract with other UV-protective compounds could lead to enhanced products for those seeking both cosmetic and protective benefits.

The ability of Lemon myrtle leaf extract to improve sleep quality and reduce anxiety adds a unique dimension to its therapeutic profile. Unlike traditional sleep aids that may come with dependency risks or side effects, such as benzodiazepines, Lemon myrtle leaf extract offers a natural, non-habit-forming alternative. The improvements in sleep onset latency, sleep quality, and deep sleep suggest that the extract's sedative effects are moderate yet effective. Given that anxiety and sleep disorders often go hand-in-hand, the anxiolytic properties of Lemon myrtle leaf extract make it especially relevant in the management of insomnia related to stress and anxiety.

This study provides strong clinical and biochemical evidence supporting the role of Lemon myrtle leaf extract as an effective natural therapy for respiratory symptom relief. Its ability to improve pulmonary function (FEV1 and PEFR), reduce inflammation (IL-6, TNF-α), enhance mucociliary clearance, and exhibit antimicrobial properties positions it as a viable alternative to synthetic bronchodilators and expectorants. With further long-term validation, it holds the potential to be incorporated into integrative respiratory care, particularly for conditions such as asthma, chronic bronchitis, and allergic rhinitis.

4. Conclusion

In conclusion, the clinical trials and efficacy evaluations of Lemon myrtle leaf extract reveal its multifaceted therapeutic potential. It holds promise as an effective treatment for skin inflammation, showing notable anti-inflammatory effects that could aid in the management of dermatological conditions. Additionally, its antioxidant properties position it as a valuable tool in combating aging-related skin damage. The sedative and sleep-enhancing effects further underscore its relevance in promoting mental health, particularly for individuals suffering from anxiety and sleep disorders. Lastly,

its efficacy in alleviating respiratory symptoms enhances its role in holistic health care. However, while the results are promising, further large-scale, well-controlled clinical studies are needed to establish standardized dosages, long-term safety, and definitive therapeutic protocols. Ultimately, lemon myrtle leaf's diverse pharmacological properties make it a strong candidate for future integrative medicine applications, especially in dermatology, sleep medicine, and respiratory care.

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