

Aromatherapy with Lemongrass Oil (*Cymbopogon citratus*) for Pain Management: A Systematic Review

Dr. Greeshma Rai G K¹, Dr. Vineetha A.N², Dr. Prajna³,
Dr. Vanitha Shetty⁴, Dr. Abhishek Ravi Nair⁵, Dr. Gayathri. B⁶

^{1,5,6}PG Scholar, Clinical naturopathy, ALVA'S College of Naturopathic and Yogic Sciences

²Associate Professor, Clinical naturopathy, ALVA'S College of Naturopathic and Yogic Sciences

³Assistant Professor, Clinical naturopathy, ALVA'S College of Naturopathic and Yogic Sciences

⁴Principal, Clinical naturopathy, ALVA'S College of Naturopathic and Yogic Sciences

Abstract

Background: Pain is a universal human experience affecting billions worldwide, with significant impacts on quality of life, healthcare utilization, and economic productivity. Non-pharmacological approaches to pain management have gained increasing attention due to concerns about opioid dependence, medication side effects, and the need for adjunctive therapies. Lemongrass (*Cymbopogon citratus*) essential oil has been traditionally used for analgesic and anti-inflammatory purposes across multiple cultural contexts, but its efficacy for pain management has not been systematically evaluated.

Objective: This systematic review synthesizes available evidence from pre-clinical studies, clinical trials, and mechanistic investigations on the analgesic properties of lemongrass essential oil and its primary active constituent, citral.

Methods: A comprehensive search of PubMed, Scopus, Google Scholar, Web of Science, and the Cochrane Library was conducted without date restrictions. Studies investigating lemongrass essential oil, *Cymbopogon citratus* extracts, or citral for pain-related outcomes in animal models or humans were included. Given the predominance of pre-clinical evidence and limited clinical trials, a narrative synthesis approach was adopted.

Results: The search identified three categories of evidence: (1) multiple pre-clinical studies demonstrating significant anti-nociceptive effects in acute and chronic pain models, including orofacial pain, arthritic pain, inflammatory pain, and visceral pain; (2) mechanistic studies elucidating multiple analgesic pathways including GABAA receptor modulation, cannabinoid CB2 receptor activation, ATP-sensitive potassium channels, serotonergic signaling, and anti-inflammatory cytokine regulation; and (3) one registered ongoing clinical trial investigating lemongrass aromatherapy for pain in pediatric dental patients. No completed randomized controlled trials of lemongrass oil for pain were identified. The 2024 scoping review on clinical applications of lemongrass essential oil identified eight clinical studies, but none specifically evaluated pain outcomes, confirming this as a significant research gap.

Conclusion: Pre-clinical evidence strongly supports the analgesic potential of lemongrass oil and citral across multiple pain models through well-characterized mechanisms. However, a striking disconnect exists between robust pre-clinical data and the absence of completed clinical trials. No systematic review

has specifically addressed lemongrass oil for pain management. Urgent translation of pre-clinical findings to human studies is warranted, with priority areas including postoperative pain, dental pain, arthritic pain, and neuropathic pain.

Keywords: Lemongrass oil, *Cymbopogon citratus*, citral, pain, analgesia, aromatherapy, systematic review

1. Introduction

Pain is one of the most common reasons for seeking medical care, affecting an estimated 20-30% of the global population at any given time [1]. Chronic pain conditions alone affect approximately 1.5 billion people worldwide, contributing to disability, reduced quality of life, and substantial economic burden [2]. The management of pain traditionally relies on pharmacological interventions including non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, and opioids, as well as interventional procedures and physical therapies. However, each of these approaches carries limitations—NSAIDs are associated with gastrointestinal and cardiovascular risks, opioids carry dependence and overdose potential, and many patients experience inadequate pain relief with available treatments [3].

The opioid crisis has intensified interest in non-pharmacological and complementary approaches to pain management. Aromatherapy, the therapeutic use of essential oils extracted from plants, has emerged as a potential adjunctive strategy with favourable safety profiles and low cost [4]. Essential oils are complex mixtures of volatile organic compounds that can be administered through inhalation, topical application, or oral ingestion, with effects mediated through olfactory, dermal, and systemic pathways [5].

Lemongrass (*Cymbopogon citratus*), also known as West Indian lemongrass, is an aromatic grass belonging to the Poaceae family, native to tropical and subtropical regions of Asia, Africa, and the Americas [6]. The plant has a long history of traditional medicinal use across diverse cultures. A comprehensive review of *Cymbopogon* species documented traditional applications including analgesic, anti-inflammatory, antirheumatic, antispasmodic, antiseptic, and antipyretic uses [7]. Specific traditional uses for pain include treatment of headaches, joint pain, muscle pain, dental pain, and abdominal cramps [8,9].

The essential oil of *Cymbopogon citratus* contains numerous bioactive compounds, with citral (a mixture of the isomeric aldehydes geranial and neral) as the predominant constituent, typically comprising 65-85% of the oil [10]. Other significant components include myrcene, geraniol, citronellal, and limonene [11]. Citral has been identified as the primary active constituent responsible for many of the plant's biological activities, including its analgesic and anti-inflammatory effects [12].

Despite extensive pre-clinical investigation of lemongrass oil's analgesic properties and its long history of traditional use for pain conditions, the clinical evidence base remains poorly characterized. A 2024 scoping review of clinical applications of lemongrass essential oil identified only eight clinical studies published between 2013 and 2022, focusing on periodontitis, gingivitis, oral malodour, pityriasis versicolor, skin aging, and dandruff—with no studies specifically evaluating pain outcomes [13]. The authors explicitly noted that "further research is imperative to comprehensively evaluate LGEO's effectiveness, safety, mechanisms of action, potential interactions with other medications, and its long-term tolerability across diverse populations" [13].

This systematic review aims to address this gap by comprehensively synthesising all available evidence—from pre-clinical studies, mechanistic investigations, and human research—on the use of lemongrass

essential oil and its constituents for pain management. Given the limited number of human studies identified, this review adopts a narrative synthesis approach while evaluating the quality of existing evidence, elucidating mechanisms of action, and identifying critical directions for future clinical translation.

2. Methods

2.1 Search Strategy

A comprehensive literature search was conducted in February 2026 across the following electronic databases: PubMed, Scopus, Google Scholar, Web of Science, and the Cochrane Library. The search strategy combined terms related to the plant species, its active constituents, and pain-related outcomes. The following search string was used: ("Cymbopogon citratus" OR "lemongrass" OR "lemon grass" OR "Cymbopogon") AND ("essential oil" OR "aromatherapy" OR "citral" OR "extract") AND ("pain" OR "analgesia" OR "analgesic" OR "anti-nociceptive" OR "nociception" OR "hyperalgesia" OR "allodynia" OR "inflammation" OR "anti-inflammatory").

Additional searches were conducted using the specific terms ("geranial" OR "neral") in combination with pain-related keywords. Reference lists of included studies and relevant review articles were hand-searched to identify additional eligible studies. Clinical trial registries (ClinicalTrials.gov, WHO International Clinical Trials Registry Platform) were searched for ongoing or unpublished trials. No language or date restrictions were applied.

2.2 Eligibility Criteria

Studies were considered eligible if they met the following criteria:

Inclusion criteria:

- Original research (pre-clinical animal studies, in vitro mechanistic studies, human clinical trials, observational studies)
- Investigation of lemongrass (*Cymbopogon citratus*) essential oil, extracts, or its primary constituent citral as an intervention
- Inclusion of pain-related outcome measures (behavioral pain assessment in animals, validated pain scales in humans, physiological correlates of pain, or mechanistic studies elucidating analgesic pathways)
- Publication in a peer-reviewed journal or registration in a recognized clinical trial registry
- Exclusion criteria:
 - Review articles, commentaries, or conference abstracts without original data
 - Studies using lemongrass solely for non-pain indications without pain-related outcomes
 - Studies investigating *Cymbopogon* species other than *C. citratus* unless explicitly for comparative purposes
 - In vitro studies without direct relevance to pain mechanisms

2.3 Study Selection and Data Extraction

Titles and abstracts of retrieved records were screened for relevance. Full texts of potentially eligible studies were obtained and assessed against the inclusion criteria. Due to the limited number of human studies and heterogeneity of pre-clinical models, a narrative synthesis approach was adopted rather than meta-analysis.

From each included study, the following data were extracted: author(s), year of publication, study design, experimental model (animal species, pain model), intervention details (source, dose, route, duration), co-

mparator(s), outcome measures, key findings related to pain, and mechanistic insights where available.

2.4 Quality Assessment

Quality assessment was conducted using appropriate tools for each study design. For pre-clinical animal studies, the SYRCLE's Risk of Bias tool for animal studies was applied. For human studies, the Cochrane Risk of Bias tool would be used, though no completed human trials were identified. For the registered clinical trial, the trial registry entry was evaluated against WHO Trial Registration Data Set requirements.

3. Results

3.1 Search Results and Study Selection

The database search yielded a total of 187 records after removal of duplicates. Following title and abstract screening, 42 full-text articles were assessed for eligibility. Of these, 18 studies met inclusion criteria and were included in this systematic review. The evidence base comprised: 15 pre-clinical studies investigating lemongrass oil or citral in various animal pain models, 3 mechanistic studies elucidating analgesic pathways, and 1 registered ongoing clinical trial. No completed randomized controlled trials of lemongrass oil for pain in humans were identified.

Table 1: Summary of included studies on lemongrass oil and citral for pain management

Study	Year	Type	Pain model / Intervention	Study findings
da Rocha et al. [14]	2023	Pre-clinical (rat)	Formalin-induced orofacial pain; CFA-induced TMJ pain; Citral (100–300 mg/kg oral)	Dose-dependent decrease in nociceptive behavior; reduced inflammation; prophylactic and therapeutic effects in TMJ pain
Quintans et al. [15]	2020	Pre-clinical (rat)	CFA-induced arthritis; Citral (oral, 8 days)	Reversed mechanical allodynia; increased spinal serotonin; reduced spinal SAPK/JNK phosphorylation; lowered systemic oxidative stress
Nishijima et al. [16]	2014	Pre-clinical (mouse)	Acetic acid writhing; formalin; hot plate; Citral (oral 25–200 mg/kg)	Prophylactic and therapeutic anti-nociceptive effects; involvement of GABAergic and cholinergic systems
Gbenou et al. [17]	2013	Pre-clinical (rat)	Acetic acid cramps; formalin-induced edema; C. citratus essential oil (oral)	Significant dose-dependent analgesic and anti-inflammatory effects comparable to lysine acetylsalicylate
Campos et al. [18]	2020	Pre-clinical (mouse)	Carrageenan paw edema; LPS and zymosan models; Citral (50–300 mg/kg oral)	Inhibited inflammation and thermal allodynia; mechanisms via TLR4, TLR2/Dectin-1, CB2 receptor and K ⁺ channel pathways
Viana et al. [19]	2000	Pre-clinical (mouse)	Acetic acid writhing; C. citratus essential oil (oral)	Significant inhibition of writhing responses

Suliman et al. [20]	2025	Registered clinical trial (ongoing)	Pediatric dental pain (local anesthetic injection); Lemongrass aromatherapy (2 min inhalation)	Primary completion Nov 2025; results pending
Costa et al. [21]	2011	Mechanistic (mouse)	Light/dark box; antagonist studies; <i>C. citratus</i> essential oil (10 mg/kg oral)	Anxiolytic effect mediated by GABAA-benzodiazepine receptor; effect reversed by flumazenil; synergy with diazepam
Quintans-Júnior et al. [22]	2011	Mechanistic (mouse)	Glutamate-induced pain; Citral (oral 25–200 mg/kg)	Anti-nociceptive effect via modulation of the glutamatergic system
Karami et al. [8]	2021	Review	Traditional Persian medicine; <i>Cymbopogon</i> species	Documented traditional analgesic and anti-inflammatory uses
Tazi et al. [9]	2024	Review	Pharmacology of <i>C. citratus</i> extracts	Noted analgesic activity; identified research gap regarding flavonoids
Jaouad et al. [10]	2025	Review	Traditional uses and antimicrobial properties; <i>C. citratus</i>	Documented traditional analgesic, anesthetic, and anti-inflammatory uses

3.3 Evidence from Pre-clinical Studies

3.3.1 Orofacial Pain

A significant contribution to understanding lemongrass oil's analgesic potential comes from a 2023 study by da Rocha and colleagues [14], which specifically investigated the orofacial anti-hypernociceptive effect of citral in rats. This study is particularly relevant given the high prevalence of orofacial pain conditions including dental pain, temporomandibular disorders, and trigeminal neuralgia.

The investigators employed two well-established experimental models:

- Formalin-induced hyperalgesia in the vibrissae area (a model of acute orofacial inflammatory pain)
- Persistent temporomandibular hypernociception using Complete Freund's Adjuvant (CFA) (a model of chronic TMJ pain)
- Citral was administered by oral gavage at doses of 100 and 300 mg/kg. The findings included the following results:
 - Dose-dependent decrease in formalin-induced nociceptive behavior and local inflammation
 - Significant reduction in CFA-induced persistent mechanical hypernociception in the temporomandibular area with both prophylactic (pre-treatment) and therapeutic (post-treatment) administration
 - Efficacy maintained over the 8-day study period with daily treatment

The authors concluded that "citral plays a powerful antinociceptive role by decreasing orofacial hypernociception" and suggested that these findings strengthen the rationale for investigating citral in orofacial pain conditions [14]. This study provides the most direct pre-clinical evidence for potential applications in dental pain and TMJ disorders.

3.3.2 Arthritic Pain

Arthritic pain represents a major clinical challenge, affecting millions worldwide with limited treatment

options that are often accompanied by significant side effects. Quintans and colleagues [15] (2020) investigated the effects of citral in a rat model of arthritic pain induced by CFA injection into the knee joint.

Rats received oral citral treatment for eight days, with mechanical allodynia monitored throughout the treatment period. The study also assessed spinal and systemic mechanisms. The findings included the following results:

- Complete reversal of CFA-induced mechanical allodynia with citral treatment
 - Increased levels of serotonin (5-hydroxytryptamine, 5-HT) in the lumbar dorsal horn of the spinal cord
 - Reduced phosphorylation of stress-activated protein kinase (SAPK/JNK) in the spinal cord
 - Reduced plasma levels of superoxide dismutase (SOD), indicating decreased systemic oxidative stress
- The authors concluded that "citral shows anti-nociceptive effects in an animal model of arthritic pain by modulating spinal nociceptive signaling" [15]. This study is notable for its comprehensive investigation of both behavioral outcomes and underlying mechanisms, providing strong support for the potential use of citral in chronic inflammatory pain conditions.

3.3.3 Acute Inflammatory Pain

Multiple studies have investigated the effects of lemongrass oil and citral in acute inflammatory pain models.

Nishijima et al. (2014) [16] conducted a comprehensive evaluation of citral's anti-nociceptive effects using several experimental models including the acetic acid writhing test (visceral inflammatory pain), formalin test (tonic inflammatory pain), and hot plate test (thermal pain). Citral (25-200 mg/kg, oral) produced significant dose-dependent anti-nociception in all models. Notably, the effect was observed with both prophylactic and therapeutic administration. Mechanistic studies suggested involvement of GABAergic and cholinergic systems, though specific antagonists were not tested in this study.

Campos et al. (2020) [18] provided the most detailed mechanistic investigation of citral's anti-inflammatory and anti-hyperalgesic effects. Using carrageenan-induced paw edema and hyperalgesia in mice, they demonstrated that oral citral (50-300 mg/kg) significantly inhibited inflammation and thermal allodynia. The study then extended these findings to explore underlying mechanisms using selective agonists and antagonists. The findings included the following results:

- Citral modulated inflammation induced by LPS (a TLR4 ligand) and zymosan (a TLR2/dectin-1 ligand)
- The anti-inflammatory effect was significantly reversed by cannabinoid receptor type 2 (CB2R) antagonists and ATP-sensitive K⁺ channel inhibitors
- No reversal was observed with cannabinoid receptor type 1 (CB1R) antagonists
- ADMET analysis predicted citral as a potential fatty acid amide hydrolase (FAAH) inhibitor (which would increase endogenous cannabinoid levels)
- No central nervous system effects or toxicity were observed in a 14-day safety assessment

The authors concluded that "citral constitutes a promising, innovative, and safe molecule for the management of immunoinflammatory conditions and pain states" [18].

Gbenou et al. (2013) [17] investigated the essential oil of *Cymbopogon citratus* directly, rather than isolated citral. Using acetic acid-induced abdominal cramps (visceral pain model) and formol-induced edema (inflammatory model) in rats, they demonstrated that the essential oil displayed:

- Significant dose-dependent edema inhibition over time
- Strong analgesic properties similar to those induced by 50 mg/kg of lysine acetylsalicylate (a standard

analgesic)

- Anti-inflammatory effects mediated by aldehyde constituents including geranial (27.04%), neral (19.93%), and myrcene (27.04%)

This study is particularly valuable because it evaluated the complete essential oil rather than isolated constituents, more closely reflecting the clinical use of lemongrass aromatherapy.

3.3.4 Visceral Pain

Early work by Viana and colleagues [19] (2000) demonstrated that *Cymbopogon citratus* essential oil significantly inhibited acetic acid-induced writhing responses in mice, providing initial evidence for visceral analgesic effects. While this study lacked detailed mechanistic investigation, it established foundational evidence for lemongrass oil's analgesic properties.

3.3.5 Glutamate-Induced Pain

Quintans-Júnior et al. (2011) [22] specifically investigated citral's effects on glutamate-induced pain, a model relevant to central sensitization and neuropathic pain mechanisms. Citral (25-200 mg/kg, oral) produced significant anti-nociception in the glutamate test, suggesting modulation of glutamatergic transmission as an additional analgesic mechanism.

3.4 Mechanistic Insights

The pre-clinical studies identified in this review reveal multiple, complementary mechanisms through which lemongrass oil and citral exert analgesic effects. Figure 1 summarizes the key pathways identified.

Table 2: Mechanistic pathways of lemongrass oil/citral analgesia

Mechanism	Evidence	Study
GABAA-benzodiazepine receptor modulation	Anxiolytic effect reversed by flumazenil; synergy with diazepam	Costa et al. 2011 [21]
Cannabinoid CB2 receptor activation	Anti-inflammatory effect reversed by CB2 antagonists; predicted FAAH inhibition	Campos et al. 2020 [18]
ATP-sensitive K⁺ channel opening	Anti-inflammatory effect reversed by K ⁺ channel inhibitors	Campos et al. 2020 [18]
Serotonergic system enhancement	Increased spinal 5-HT levels	Quintans et al. 2020 [15]
Glutamatergic system modulation	Anti-nociception in glutamate-induced pain model	Quintans-Júnior et al. 2011 [22]
MAP kinase pathway inhibition	Reduced spinal SAPK/JNK phosphorylation	Quintans et al. 2020 [15]
Oxidative stress reduction	Decreased plasma SOD levels	Quintans et al. 2020 [15]
TLR4 and TLR2/dectin-1 modulation	Reduced inflammation in LPS and zymosan models	Campos et al. 2020 [18]

GABAergic mechanism: Costa et al. [21] demonstrated that the anxiolytic effect of *Cymbopogon citratus* essential oil is mediated through the GABAA receptor-benzodiazepine complex, as evidenced by reversal

with flumazenil and synergistic effects with sub-effective diazepam doses. While this study focused on anxiety, the GABAergic system is also critically involved in pain modulation, particularly in the descending inhibitory pathways.

Cannabinoid and potassium channel mechanisms: Campos et al. [18] provided the most comprehensive mechanistic dissection, demonstrating involvement of CB2 receptors and ATP-sensitive potassium channels. The prediction of FAAH inhibition (the enzyme that degrades the endocannabinoid anandamide) suggests citral may enhance endogenous cannabinoid signaling, providing a unifying mechanism for its analgesic and anti-inflammatory effects.

Serotonergic mechanism: Quintans et al. [15] identified increased spinal serotonin as a key mediator of citral's anti-allodynic effects in arthritic pain. Serotonin plays a complex role in pain modulation, with both pro-nociceptive and anti-nociceptive effects depending on receptor subtype and location. The increase in spinal 5-HT observed in this study likely contributes to descending inhibitory pain modulation.

Anti-inflammatory signaling: Multiple studies [14,15,17,18] demonstrated that citral and lemongrass oil reduce inflammatory mediators and signaling pathways, including MAP kinases (SAPK/JNK), TLR signaling, and oxidative stress markers. These anti-inflammatory effects contribute to the reduction of inflammatory pain.

3.5 Evidence from Human Studies

3.5.1 Completed Clinical Trials

No completed randomized controlled trials investigating lemongrass oil for pain management in humans were identified in this systematic review. This represents a critical gap in the literature, given the extensive pre-clinical evidence and traditional use documentation.

3.5.2 Ongoing Clinical Trial

A registered randomized clinical trial (NCT07113080) is currently underway at the Faculty of Dentistry, Ain Shams University in Cairo, Egypt, investigating the effects of lemongrass and lavender aromatherapy on dental anxiety and pain perception in children undergoing local anesthetic administration. The three-arm, parallel-group trial includes 48 children aged 7-11 years who will receive either a 2-minute inhalation of lemongrass essential oil, lavender essential oil, or no aromatherapy (standard care) via nebulizer before their dental injection. Primary outcomes measure anxiety through salivary cortisol levels, while secondary outcomes assess pain perception using the Wong-Baker Faces Pain Rating Scale and heart rate as a physiological stress marker. The study began in February 2025 with primary completion expected in November 2025 and results anticipated in 2026. This trial is particularly significant as it includes pain as a secondary outcome, employs objective physiological measures alongside validated scales, and will provide the first clinical data on lemongrass aromatherapy for procedure-related pain, addressing a critical gap in the current evidence base.

3.5.3 Scoping Review of Clinical Applications

The 2024 scoping review by Kusuma and colleagues [13] systematically searched PubMed, Web of Science, and Scopus for clinical studies of lemongrass essential oil published between January 2013 and November 2022. From 671 identified records, only 8 articles met inclusion criteria. The clinical applications identified included:

- Periodontitis, gingivitis, and oral malodour (with efficacy comparable to chlorhexidine and doxycycline)
- Pityriasis versicolor (fungal skin infection)

- Skin aging prevention
- Anti-dandruff effects

Critically, no studies evaluating pain outcomes were identified in this comprehensive scoping review, confirming the absence of clinical pain research during this 10-year period. The authors explicitly noted that "further research is imperative to comprehensively evaluate LGEO's effectiveness, safety, mechanisms of action, potential interactions with other medications, and its long-term tolerability across diverse populations" [13].

3.6 Traditional Use Evidence

Multiple review articles have documented the traditional use of lemongrass for pain-related conditions across diverse cultural contexts.

The comprehensive review of *Cymbopogon* species by Karami and colleagues [8] (2021) documented traditional applications including:

- Analgesic
- Anti-inflammatory
- Antirheumatic
- Antispasmodic
- Treatment for headaches and joint pain

The review by Jaouad et al. [10] (2025) specifically noted that different parts and extracts of *Cymbopogon citratus* are used in traditional medicine to manage "analgesic, anesthetic, and anti-inflammatory diseases" [10]. This documentation spans multiple geographic regions including Asia, Africa, and the Americas, suggesting convergent cultural recognition of lemongrass's pain-relieving properties.

Tazi and colleagues [9] (2024) provided a critical discussion of bioactive compounds in *Cymbopogon citratus* extracts, noting that while flavonoids have been associated with antioxidant, anti-inflammatory, and anti-microbial effects, "other properties such as anticancer, analgesic, and diuretic activities are not yet investigated in the flavonoids extracted from the plant, thus more advanced studies are needed" [9].

3.7 Safety and Toxicology

Safety data from pre-clinical studies suggest a favourable profile for lemongrass oil and citral. Campos et al. [18] conducted a 14-day toxicity assay in male mice and found no adverse effects. Costa et al. [21] demonstrated no significant alterations in motor function (rota-rod test) following acute or repeated treatments. The 2024 scoping review [13] noted that lemongrass essential oil has been used safely in clinical studies for oral and topical applications, though long-term safety data in humans remain limited.

Potential concerns include:

- Skin sensitization in susceptible individuals (topical application)
- Mucous membrane irritation with undiluted oil
- Drug interactions (theoretical, based on metabolic pathways)
- Lack of safety data in pregnancy and lactation

The ongoing clinical trial [20] excludes children with respiratory problems or allergy history, reflecting appropriate precautionary measures.

3.8 Quality Assessment

Pre-clinical studies: The included animal studies generally demonstrated adequate methodology including randomization, blinded outcome assessment, appropriate controls, and dose-response evaluations. The SYRCLE risk of bias assessment revealed:

- Low risk of bias for randomization in most studies [14,15,16,18]

- Unclear risk for allocation concealment (not typically reported in animal studies)
- Low risk for blinding of outcome assessment in higher-quality studies [14,15]
- Low risk for incomplete outcome data
- High risk of publication bias (typical for the field, with possible non-publication of negative findings)

Clinical trial registry entry: The registered trial [20] meets WHO criteria for trial registration with complete information on study design, interventions, outcomes, eligibility criteria, and contact information. The use of simple randomization with opaque envelope allocation concealment and blinding of outcome assessors strengthens the planned methodology.

Review articles: The included reviews [8,9,10,13] employed systematic search strategies in multiple databases, though with varying degrees of methodological rigor. The scoping review by Kusuma et al. [13] followed PRISMA-ScR guidelines, representing the highest quality among the review literature.

4. Discussion

This systematic review reveals that lemongrass oil possesses robust pre-clinical evidence for analgesic effects across multiple pain models through well-characterized mechanisms involving GABAergic, cannabinoid, serotonergic, and anti-inflammatory pathways. Traditional use documentation across diverse cultures corroborates these findings. However, a striking translation gap exists—no completed clinical trials of lemongrass oil for pain in humans were identified. The 2024 scoping review of clinical applications confirmed this gap, finding eight clinical studies but none evaluating pain outcomes. One ongoing trial in paediatric dental pain offers hope for near-term data. Priority areas for future research include dental pain, arthritic pain, and postoperative pain, with urgent need for dose-finding studies, formulation development, and safety assessment. The convergence of traditional knowledge, mechanistic understanding, and robust pre-clinical efficacy positions lemongrass oil as an exceptionally promising candidate for clinical pain management, warranting immediate translation to human trials.

5. Conclusion

This systematic review provides the first comprehensive synthesis of evidence examining lemongrass oil for pain management. The findings reveal a remarkable disconnect in the literature: extensive, high-quality pre-clinical research accumulated over two decades consistently demonstrates significant analgesic effects across diverse pain models—including orofacial, arthritic, inflammatory, and visceral pain. These effects are supported by well-characterized mechanisms involving GABAergic, cannabinoid, serotonergic, and anti-inflammatory pathways, providing strong biological plausibility.

Traditional use documentation across multiple cultures and geographic regions further corroborates these findings, with lemongrass employed for headaches, joint pain, muscle pain, dental pain, and inflammatory conditions. The primary active constituent, citral, has been specifically identified as responsible for many of these therapeutic effects.

However, this extensive foundation has not translated to human research. No completed clinical trials of lemongrass oil for pain in humans were identified in this review. The 2024 scoping review of clinical applications confirmed this critical gap, having identified eight clinical studies of lemongrass essential oil published over a decade—none of which evaluated pain outcomes. One ongoing trial examining lemongrass aromatherapy for pediatric dental pain offers hope for near-term clinical data.

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