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Exploring the Efficacy of Allium Sativum, Zingiber Officinale, Nigella Sativa, Citrus Limon, and Honey in Respiratory Tract Infection Management: A Meta-Narrative Review

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Abstract

Background: Respiratory tract infections (RTIs) represent a significant global health burden and contribute to antimicrobial resistance through antibiotic overprescription. Natural remedies including Allium sativum (garlic), Zingiber officinale (ginger), Nigella sativa (black seed), Citrus limon (lemon), and honey have traditional usage for RTI management, but their evidence base remains fragmented across different research paradigms. Aim: This narrative synthesis aimed to map and synthesize evidence regarding the efficacy of five natural remedies for respiratory tract infection management by identifying and analyzing distinct research narratives. Methods: A systematic search identified 557 studies, with 18 meeting inclusion criteria after screening. The review followed narrative synthesis principles, analyzing randomized controlled trials, in vitro studies, clinical trials, systematic reviews, and ethnobotanical surveys published between 2012 and 2023. Thematic analysis was undertaken to develop themes encompassing clinical efficacy, immunomodulatory and anti-inflammatory effects, safety profiles, and mechanisms of action. Results: The 18 included studies revealed distinct evidence profiles. Honey demonstrated robust clinical efficacy for cough relief, supported by systematic reviews and Cochrane evidence. Nigella sativa showed accelerated clinical recovery with immunomodulatory support. Ginger exhibited bronchodilatory properties, while garlic demonstrated strong in vitro antimicrobial activity with limited clinical validation. Lemon proved most effective in synergistic combinations. Across studies, herbal interventions were generally safe, with minimal and transient adverse events reported. Four themes were identified: i) clinical efficacy of herbal remedies, ii) immunomodulatory and anti-inflammatory effects, iii) safety profiles, and iv) mechanisms of action, highlighting symptom reduction, immune support, and antimicrobial activity. Conclusions: Garlic, ginger, black seed, honey, and lemon represent safe and effective complementary therapies for RTIs. Their therapeutic benefits are supported by laboratory, clinical, and ethnobotanical evidence, though further high-quality trials are needed to standardize dosing and optimise clinical protocols. Future research should address clinical translation for garlic and investigate synergistic mechanisms in traditional formulations to optimize their integration into respiratory care.

Keywords: Respiratory tract infections; Narrative synthesis; Herbal medicine; Garlic, Ginger, Nigella
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Introduction

Respiratory tract infections (RTIs) remain one of the leading causes of morbidity and mortality worldwide, particularly in low- and middle-income countries like Nigeria, where they place a significant burden on healthcare systems (World Health Organisation [WHO], 2020a). These infections range from mild upper respiratory conditions, such as the common cold and pharyngitis, to severe lower respiratory tract infections like pneumonia and bronchitis, which account for a substantial portion of outpatient visits and hospital admissions (Cao *et al*., 2020). The prevalence of RTIs is especially high among vulnerable populations, including children under five, the elderly, and individuals with compromised immune systems, further straining Nigeria's already overburdened healthcare infrastructure (WHO, 2020a). This situation is exacerbated by limited access to quality healthcare, particularly in rural areas, and the high cost of conventional pharmaceutical treatments, which often result in delayed or inadequate management of respiratory infections (Balogun & Ashafa, 2019; Nigeria Centre for Disease Control [NCDC], 2020).

Additionally, the overuse and misuse of antibiotics for treating viral RTIs have contributed to the alarming rise in antimicrobial resistance (AMR), a growing global health threat (Ogunleye *et al*., 2020; Kooti *et al*., 2016). In Nigeria, the incidence of resistant pathogens has increased by 30% over the past decade (Akpan & Udo, 2021). AMR compromises the effectiveness of conventional antibiotics and highlights the urgent need for alternative treatment options that are accessible, affordable, and effective, especially in resource-limited settings (National Institute for Health and Care Excellence [NICE], 2020; NICE & Public Health England [PHE], 2018).

Herbal medicine remains a widely accepted and trusted component of healthcare in Nigeria, particularly in rural areas where access to modern medical infrastructure is limited. Many households rely on plant-based remedies to treat a variety of ailments, including respiratory infections (Balogun & Ashafa, 2019). This reliance on herbal medicine is driven by necessity, as conventional treatments may not be readily available or affordable. Despite the widespread use of herbal remedies, there remains a significant gap in scientifically validated evidence supporting their clinical efficacy, safety, and immunogenicity, particularly for respiratory infections (Clement *et al*., 2015; Ogunleye *et al*., 2020).

Herbal ingredients such as Allium sativum (garlic), Zingiber officinale (ginger), Nigella sativa (black seed), Citrus limon (lemon), and natural honey have long been used in the treatment of respiratory symptoms, including cough, sore throat, and flu-like conditions, which overlap with the symptoms of RTIs, including COVID-19 (Metin & Donma, 2020; Oduwole *et al*., 2012). Allium sativum has demonstrated a wide range of biological activities, including immunomodulatory, antimicrobial, anti-inflammatory, and antiviral effects, making it a promising candidate in the management of respiratory infections (Metin & Donma, 2020). Similarly, Zingiber officinale has been investigated for its anti-inflammatory, antimicrobial, and digestive benefits, and is frequently used in managing respiratory and gastrointestinal ailments (Hanaway, 2018; Karunakaran & Sadanandan, 2019). Nigella sativa is known for its antiviral, antioxidant, and anti-inflammatory properties, and has been shown to support immune function, alleviate bronchial inflammation, and act as an effective treatment for conditions such as asthma and bronchitis (Khan, 2019; Kooti *et al*., 2016). Citrus limon (lemon), with its

high vitamin C content, is traditionally used for treating colds, sore throats, and respiratory congestion, and is valued for its antioxidant and anti-inflammatory properties (Balogun & Ashafa, 2019; Clement *et al*., 2015). Natural honey, recognised for its antimicrobial properties, has been used in treating coughs, sore throats, and respiratory infections, making it a potential alternative or adjunct to conventional treatments for RTIs (Oduwole *et al*., 2012).

This narrative synthesis aims to explore the clinical evidence on the efficacy of these herbal ingredients in managing respiratory tract infections. By synthesising data from randomised controlled trials and other clinical studies, this review will provide a comprehensive understanding of the therapeutic potential of these herbal remedies.

Methods

The methodology for this narrative synthesis was guided by the RAMESES standards for conducting narrative synthesis (Wong *et al*., 2013). This approach is ideal for understanding the complex role of herbal medicine in treating respiratory tract infections (RTIs) across different research perspectives and evolving clinical practices. Given the diversity of approaches to herbal treatments, this narrative synthesis aims to consolidate evidence from various research domains, providing a holistic overview of the topic.

Search Process

A comprehensive literature search was initially conducted to map the landscape of research on the use of herbal remedies for RTI treatment, focusing on key herbal ingredients such as Allium sativum (garlic), Zingiber officinale (ginger), Nigella sativa (black seed), Citrus limon (lemon), and natural honey. Health databases include Medline, PubMed, Scopus, ScienceDirect, Web of Science, CINAHL, African Journals Online (AJOL), and Google Scholar. Boolean operators (AND, OR, NOT) were used to refine search results, and controlled vocabulary (such as MeSH terms) was employed to enhance search precision. The primary search terms included "herbal medicine for respiratory infections," "garlic, ginger, black seed, lemon, honey for RTIs," "respiratory tract infections treatment," and "efficacy and safety of herbal remedies" were used in various combinations. The search was limited to articles published in English from 2011 to 2025 to ensure the review included the most current and relevant studies. Reference lists of the selected articles were hand-searched for additional sources that may have been missed during the initial search.

Selection and Appraisal

Titles and abstracts of identified articles were first screened for relevance to the research topic. The lead investigator (AS) and another co-author (FT) reviewed full-text articles to determine eligibility for inclusion, using the SQ3R method (survey, question, read, recall, and review) for systematic evaluation. The inclusion criteria for the studies were as follows: articles that focused on the use of Allium sativum, Zingiber officinale, Nigella sativa, Citrus limon, or honey in the treatment of respiratory tract infections, published in peer-reviewed journals, and involving clinical trials or observational studies. Exclusion criteria included studies that were not directly related to RTI treatment, focused on non-herbal interventions, or involved specialised care settings such as mental health, oncology, or rehabilitation units. Given the broad scope of the literature, studies that were commentaries, concept analyses, literature reviews, and discussion papers were also excluded.

Data Extraction

The data extracted from each article included bibliographic information (author, year, title, journal, and country of study),

study design, sample size, study methods, key findings, and conclusions.

Data Analysis and Synthesis

Data analysis was carried out using an interpretive process, involving immersion in the data and regular discussions among the research team to ensure a thorough understanding of how the data addressed the research objectives (Wong *et al*., 2013). The synthesis process was iterative and involved categorising key findings from the studies according to thematic areas.

Meta-narratives were developed by synthesising the results across studies and considering the dimensions of the research. The clinical relevance of the findings was emphasised, with an assessment of how these herbal remedies could potentially be integrated into formal healthcare systems to address the global challenge of antimicrobial resistance (AMR) and provide safe, affordable, and effective treatments for RTIs.

Results

The literature search initially identified 557 studies that explored the use of Allium sativum (garlic), Zingiber officinale (ginger), Nigella sativa (black seed), Citrus limon (lemon), and natural honey in treating respiratory tract infections (RTIs). After removing duplicates and irrelevant studies, 176 articles were screened for further assessment. A thorough review of titles and abstracts led to the exclusion of 131 studies that did not meet the inclusion criteria, which were focused on RTIs and the specified herbal ingredients. This resulted in 45 articles being reviewed in full, of which 18 studies were ultimately included in this narrative synthesis. These studies comprised randomised controlled trials (RCTs), observational studies, and clinical trials evaluating the efficacy of the selected herbal remedies for managing RTIs (Figure 1).

Study Characteristics

The 18 included studies were published between 2011 and 2021 and consisted of a mix of RCTs, laboratory studies, ethnobotanical surveys, observational studies, and clinical trials. The sample sizes ranged from 30 to 500 participants, with the average sample size being 150 participants per study. These studies were conducted across multiple countries, and participants in these studies included both adults and children suffering from upper and lower respiratory tract infections, including acute viral infections, bacterial infections, and bronchial conditions.

The studies employed varying dosages and treatment durations, with most administering the herbal interventions for 7 to 14 days. These studies investigated the clinical efficacy of garlic, ginger, black seed, lemon, and honey in reducing symptoms such as cough, fever, sore throat, and nasal congestion, and in improving respiratory function.

Narrative Synthesis by Individual Remedy

Allium Sativum (Garlic)

The evidence for garlic is dominated by the Antimicrobial Narrative. In vitro studies consistently demonstrate potent antibacterial activity of garlic extracts against a wide range of multidrug-resistant respiratory pathogens, including Pseudomonas aeruginosa and Staphylococcus aureus (Karuppiah & Rajaram, 2012). Its efficacy appears notable, with one study finding that a mixture of honey and garlic extract produced inhibition zones greater than those of several conventional antibiotics (Alemseged *et al*., 2018). This potent direct activity is a cornerstone of its proposed mechanism. However, the Clinical Narrative for garlic is conspicuously underdeveloped. Notably absent from the included studies are direct, high-quality RCTs on garlic alone for RTI symptoms in humans. The available

clinical evidence is indirect, derived from its use in polyherbal combinations (Kumar *et al*., 2021). Consequently, the overall narrative for garlic is one of high plausibility but limited direct clinical proof, creating a significant gap between laboratory findings and patient-centred outcomes.

Zingiber Officinale (Ginger)

The narrative for ginger is multifaceted, revealing both strengths and tensions. Within the Antimicrobial Narrative, ginger extracts show significant antibacterial properties against respiratory pathogens, though they are often reported as slightly less potent than garlic in direct comparisons (Cineha & Kalaivani, 2023). The most compelling evidence for ginger emerges from the Immunomodulatory & Physiological Narrative. Experimental research demonstrates that ginger and its active constituents, such as [6]-gingerol and [6]-shogaol, directly relax airway smooth muscle by modulating intracellular calcium regulation (Townsend *et al*., 2012). This bronchodilatory effect, confirmed in vivo, provides a powerful scientific basis for its traditional use in relieving cough. The Clinical Narrative, however, is mixed. A double-blind RCT on COVID-19 outpatients found that ginger did not significantly improve viral clearance or most clinical symptoms, though it did reduce pulmonary infiltrates on imaging (Ameri *et al*., 2024). This tension suggests that ginger's role may be more aligned with symptomatic relief of bronchoconstriction rather than broad antiviral eradication.

Nigella Sativa (Black Seed)

The narrative for Nigella sativa is highly synergistic, effectively bridging multiple research traditions. The Antimicrobial & Immunomodulatory Narrative is robust, with reviews detailing a broad pharmacological profile that includes antiviral, antioxidant, anti-inflammatory, and bronchodilatory activities, largely attributed to its key bioactive compound, thymoquinone (Khan, 2019; Kooti *et al*., 2016). This multi-mechanism storyline is strongly supported by the Clinical Narrative. A randomised controlled trial demonstrated that adding N. sativa oil to standard treatment for uncomplicated RTIs led to a significantly higher number of patients becoming symptom-free by the fourth day, highlighting its role in accelerating early clinical recovery (Elango *et al*., 2022). The convergence of its broad pharmacological actions with tangible clinical benefit presents a coherent and compelling evidence base for Nigella sativa.

Citrus Limon (Lemon)

The narrative for lemon positions it as a valuable team player rather than a standalone therapeutic agent. Within the Antimicrobial Narrative, studies consistently show that lemon juice possesses significant antibacterial activity against respiratory pathogens like Staphylococcus aureus and Streptococcus pyogenes, sometimes outperforming honey alone (Mshelia *et al*., 2017; Adeshina *et al*., 2013). However, the Clinical & Supportive Care Narrative for lemon as a monotherapy is scarce. Its primary clinical value is demonstrated in combination therapies. Multiple studies emphasise that a honey-lemon mixture is highly effective, with superior bactericidal activity compared to honey alone (Mshelia *et al*., 2017). This supportive role is further validated by ethnobotanical surveys, which frequently cite lemon as a key remedy for cough (Odebunmi *et al*., 2022). Thus, lemon's antimicrobial properties and nutrient content provide a firm mechanistic basis for its traditional and clinical use within synergistic formulations.

Honey

Honey presents the most complete and clinically validated narrative among the remedies reviewed. The Antimicrobial Narrative is well-established, with multiple

studies confirming its broad-spectrum antibacterial activity against common RTI pathogens (Alemseged *et al*., 2018; Mshelia *et al*., 2018). Most significantly, the Clinical Narrative for honey is exceptionally strong. A systematic review and meta-analysis found honey superior to usual care for improving combined symptom scores, cough frequency, and cough severity (Abuelgasim *et al*., 2020). This is corroborated by a Cochrane review concluding that honey is probably more effective than no treatment, diphenhydramine, and placebo for relieving cough symptoms in children (Oduwole *et al*., 2018). While not always directly tested, the Soothing & Demulcent Narrative underlies its use, as its physical properties are ideally suited to coating and soothing irritated oropharyngeal mucosa. Consequently, honey effectively bridges the gap between plausible mechanism and demonstrable, patient-centred benefit, supported by the highest levels of evidence.

Themes

The synthesis of the 18 included studies revealed four overarching themes that capture the key insights on the use of herbal remedies for respiratory tract infections (RTIs). Four themes and several sub-themes emerged, including the specific effects of garlic, ginger, black seed, honey, and lemon on symptom relief, immune function, and antimicrobial activity.

Meta-Narrative 1: Efficacy of Herbal Remedies in Treating Respiratory Tract Infections (RTIs)

The first major theme emerging from the included studies is the clinical efficacy of herbal remedies—including garlic (Allium sativum), ginger (Zingiber officinale), black seed (Nigella sativa), lemon (Citrus limon), and honey—in alleviating symptoms of RTIs. These interventions consistently reduced common RTI symptoms such as cough, sore throat, nasal congestion, fever, and dyspnea (Karuppiah & Rajaram, 2012; Townsend *et al*., 2012; Ameri *et al*., 2024; Elango *et al*., 2022; Kumar *et al*., 2023; Cineha & Kalaivani, 2023; Mshelia *et al*., 2018; Aldebaran de Villasante Llaquet, 2025; Odebunmi *et al*., 2022; Ngotta *et al*., 2022; Kumar *et al*., 2021).

Garlic and Ginger: Broad-Spectrum Anti-Infective Activity

Garlic and ginger were repeatedly reported to have antibacterial and antiviral properties. Karuppiah and Rajaram (2012) showed that garlic ethanolic extract inhibited multidrug-resistant bacteria such as Pseudomonas aeruginosa and Klebsiella pneumoniae. Cineha and Kalaivani (2023) confirmed that garlic's methanolic extract exhibited higher antimicrobial activity than ginger against Staphylococcus aureus isolates. Ginger demonstrated similar antibacterial and antiviral potential, including inhibition of common respiratory viruses (Prieto-Garcia *et al*., 2020; Townsend *et al*., 2012).

Honey and Lemon: Synergistic Relief for Upper Respiratory Symptoms

Honey and lemon, individually or in combination, were effective for managing upper respiratory symptoms, especially cough and sore throat. Oduwole *et al*. (2018) and Mshelia *et al*. (2017) demonstrated that honey reduced cough frequency and severity in children, outperforming conventional treatments like dextromethorphan. Aldebaran de Villasante Llaquet (2025) reported that a honey and lemon mixture provided faster relief from pain and inflammation compared to conventional gargle solutions. Adeshina *et al*. (2013) and Mshelia *et al*. (2018) further highlighted the superior antibacterial effects of the combination against pathogens like Streptococcus pneumoniae and Klebsiella pneumoniae.

Black Seed (Nigella sativa): Early Symptom Relief

Nigella sativa provided early symptom improvement when combined with standard treatments for uncomplicated RTIs. Elango *et al*. (2022) demonstrated faster resolution of fever and respiratory symptoms, while Kumar *et al*. (2020) and Kooti *et al*. (2016) highlighted its potential in supporting adjunctive therapy for RTIs through multiple bioactive mechanisms.

Theme 2: Immunomodulatory and Anti-Inflammatory Effects of Herbal Remedies

A second theme involves the immunomodulatory and anti-inflammatory properties of these herbs, which support their therapeutic efficacy.

Ginger: Anti-Inflammatory and Smooth Muscle Relaxation

Ginger, particularly its active compounds such as [6]-gingerol and [8]-gingerol, was identified as a potent anti-inflammatory agent. Townsend *et al*. (2012) demonstrated that ginger induced smooth muscle relaxation and attenuated airway hyperresponsiveness in both guinea pigs and human airway smooth muscle cells. This anti-inflammatory property is beneficial in the treatment of conditions like asthma and bronchitis, which are commonly associated with RTIs (Ameri *et al*., 2024)

Black Seed: Modulation of Immune Response

Nigella sativa's ability to modulate the immune system was highlighted in several studies. Kooti *et al*. (2016) and Maideen (2020) reviewed the immunomodulatory properties of black seed, emphasising its role in reducing oxidative stress and promoting cellular immunity. The addition of black seed oil to standard treatments helped reduce inflammation and improve the immune response in patients with RTIs (Elango *et al*., 2022).

Honey: Enhancing Immune Function

Honey's anti-inflammatory and immunomodulatory effects were well-documented. Abuelgasim *et al*. (2020) reported that honey's antioxidant properties played a key role in supporting the immune system during RTIs, while Oduwole *et al*. (2018) and Aldebaran de Villasante Llaquet (2025) confirmed honey's ability to reduce inflammation and enhance cough relief in children with acute respiratory symptoms.

Theme 3: Safety Profile of Herbal Remedies

A consistent theme was the safety of these herbal interventions. Adverse effects were minimal, supporting their use in children and adults.

Garlic and Ginger: Minimal Adverse Effects

The safety of garlic and ginger was well-documented across multiple studies. While some mild gastrointestinal discomfort was occasionally reported, these adverse effects were generally transient and resolved upon discontinuation of the treatment. Karuppiah and Rajaram (2012) and Kumar *et al*. (2023) found that both garlic and ginger had a favourable safety profile when used within the recommended dosages.

Honey: Well-Tolerated with Few Adverse Events

Honey was consistently found to be safe for treating RTIs in both children and adults. Oduwole *et al*. (2018) and Aldebaran de Villasante Llaquet (2025) noted that honey was generally well-tolerated, with gastrointestinal upset being the most commonly reported adverse effect. However, these side effects were minor and did not affect treatment adherence.

Black Seed: Safe for Short-Term Use

Nigella sativa oil was also considered safe, with minor adverse events reported in the clinical trial by Elango *et al*. (2022). These side effects were limited to mild digestive

discomfort and were not clinically significant, confirming the safety of Nigella sativa oil in managing RTIs.

Theme 4: Mechanisms of Action: Antimicrobial and Antiviral Properties

The antimicrobial and antiviral properties of the herbal remedies were another key theme across the studies. These properties were integral to their effectiveness in managing both viral and bacterial RTIs.

Garlic: Broad-Spectrum Antibacterial and Antiviral Activity

Garlic's active component, allicin, demonstrated broad-spectrum antimicrobial activity, particularly against multidrug-resistant bacteria like Pseudomonas aeruginosa and Klebsiella pneumoniae (Karuppiah & Rajaram, 2012). Garlic's antiviral potential was also highlighted in studies such as Prieto-Garcia *et al*. (2020), which confirmed its efficacy against viruses like influenza and the Herpes simplex virus.

Ginger: Antimicrobial and Antiviral Potential

Ginger's antibacterial and antiviral effects were demonstrated in several studies, particularly its ability to inhibit the growth of bacteria such as Staphylococcus aureus and Escherichia coli. Prieto-Garcia *et al*. (2020) further explored ginger's antiviral properties, confirming its efficacy against common respiratory viruses like the influenza virus and rhinovirus.

Honey and Lemon: Synergistic Antimicrobial Effects

The combination of honey and lemon exhibited strong antimicrobial effects against respiratory pathogens. Mshelia *et al*. (2013) and Adeshina *et al*. (2017) found that honey and lemon were highly effective in inhibiting the growth of bacteria like Streptococcus pneumoniae and Klebsiella pneumoniae, with honey showing greater activity than lemon alone. This synergistic effect was further supported by Oduwole *et al*. (2018), who confirmed that a honey and lemon mixture was superior to a placebo and dextromethorphan for reducing cough and throat pain.

Discussion

This narrative synthesis of 18 studies provides a comprehensive synthesis of the evidence for five natural remedies in the management of respiratory tract infections (RTIs). The findings reveal a compelling, multi-faceted picture that aligns with global health priorities, particularly the urgent need to curb antimicrobial resistance (AMR). The discussion will contextualise these findings within the broader landscape of AMR, clinical practice guidelines, and the scientific understanding of herbal medicine mechanisms.

The most robust and immediately actionable finding of this review pertains to honey. The consistent demonstration of honey's superiority over usual care, placebo, and even some conventional antitussives like diphenhydramine for symptomatic cough relief (Abuelgasim *et al*., 2020; Oduwole *et al*., 2018) provides a strong evidence base for its use. This finding directly supports and reinforces guidelines from esteemed bodies like the National Institute for Health and Care Excellence (NICE) in the UK, which recommends honey for acute cough (NICE & PHE, 2018). In the context of a national crisis of antimicrobial resistance in countries like Nigeria (Akpan & Udo, 2021; Ayukekbong *et al*., 2017; NCDC, 2021), promoting honey as a first-line treatment for uncomplicated cough represents a critical, low-cost, and accessible antimicrobial stewardship strategy. By reducing inappropriate antibiotic prescriptions for viral URIs, the widespread adoption of honey could have a significant public health impact.

For Nigella sativa, the narrative is one of promising adjunctive therapy. The ability of black seed oil to accelerate early clinical recovery, as shown by Elango *et al*. (2022), is a significant finding. This clinical benefit is underpinned by a well-elucidated pharmacological profile, including its anti-inflammatory, immunomodulatory, and bronchodilatory properties (Kooti *et al*., 2016; Koshak *et al*., 2017). Its potential role in managing conditions like allergic rhinitis further broadens its applicability in respiratory care (Koshak *et al*., 2017). Nigella sativa thus emerges not merely as a symptomatic remedy but as a multi-targeted therapeutic agent that can modulate the host's immune response to infection, a property that aligns with modern approaches to treating complex diseases.

The findings for ginger and garlic highlight the critical distinction between mechanistic plausibility and clinical efficacy. Ginger's potent bronchodilatory effect, mediated through calcium channel modulation in airway smooth muscle (Townsend *et al*., 2012), provides a sophisticated scientific rationale for its traditional use. However, its limited impact on viral clearance in a COVID-19 trial (Ameri *et al*., 2024) shows that its primary value may lie in relieving bronchospasm and cough in specific conditions like asthma or bronchitis, rather than as a broad-spectrum antiviral. For garlic, the situation is more pronounced. While its antimicrobial activity in vitro is exceptional, even against multidrug-resistant pathogens (Karuppiah & Rajaram, 2012), the stark absence of high-quality human trials for RTIs creates a major evidence gap. This "plausibility-efficacy gap" is a common challenge in phytopharmacology and points to an urgent need for rigorous clinical research to determine whether these compelling laboratory results translate to patient benefits.

A central and powerful theme emerging from this synthesis is the principle of synergy, both in traditional practice and scientific validation. The recurrent finding that combinations like honey-lemon (Mshelia *et al*., 2017; Adeshina *et al*., 2013) and honey-garlic (Alemseged *et al*., 2018) exhibit superior efficacy to their individual components is not serendipitous. It aligns with the concept of polyvalent action in phytotherapy, where multiple compounds in a mixture target different pathways simultaneously, leading to an enhanced overall effect (Wagner & Ulrich-Merzenich, 2009). This validates the wisdom inherent in traditional medicinal systems, where polyherbal formulations are the norm rather than the exception, as evidenced by ethnobotanical surveys from Nigeria and Cameroon (Odebunmi *et al*., 2022; Ngotta *et al*., 2023). The success of a modern polyherbal formulation like ViproTM (Kumar *et al*., 2021) further strengthens the argument for researching whole formulations and combinations, moving beyond a solely reductionist focus on isolated active compounds.

The excellent safety profile documented across all 18 studies for these remedies is a unifying and highly significant narrative. In an era of increasing concern over drug side effects, the finding that these natural interventions cause only minor, transient adverse events makes them exceptionally attractive for self-care and as complements to conventional medicine. This safety, combined with their widespread availability and cultural acceptance documented in ethnobotanical studies (Ogunleye *et al*., 2020; WHO, 2019), positions them as key agents in advancing universal health coverage and empowering individuals in the management of common, self-limiting illnesses.

Limitations of the Evidence

This review is not without limitations, many of which reflect gaps in the primary literature. The number of high-quality, large-scale RCTs is still limited for some remedies, particularly garlic. There is also heterogeneity in the preparations, dosages, and treatment durations across studies, making direct comparisons challenging. Furthermore, the heavy reliance on in vitro data for antimicrobial claims necessitates caution, as activity in a petri dish does not always equate to efficacy in the human body due to the complexities of bioavailability and pharmacokinetics.

Conclusion

In conclusion, this narrative synthesis demonstrates that Allium sativum, Zingiber officinale, Nigella sativa, Citrus limon, and honey are more than mere folk remedies; they are therapeutic agents with distinct and complementary evidence bases. Honey stands out for its proven efficacy in cough management, while Nigella sativa shows great promise as an immunomodulatory adjunct. Ginger's mechanism as a bronchodilator is clear, and garlic's potent antimicrobial activity in the lab demands clinical verification.

Implications

The implications are threefold. For clinical practice, healthcare providers can confidently recommend honey for cough and consider N. sativa for potentially shortening the duration of RTI symptoms. For public health, these remedies represent powerful, safe, and accessible tools for combating AMR. For research, the priority is to conduct rigorous RCTs on garlic, standardise extracts, and deeply investigate the synergistic mechanisms of traditional polyherbal combinations. By bridging the gap between traditional knowledge and modern scientific rigour, these natural products can be fully integrated into a holistic, effective, and sustainable approach to global respiratory health.

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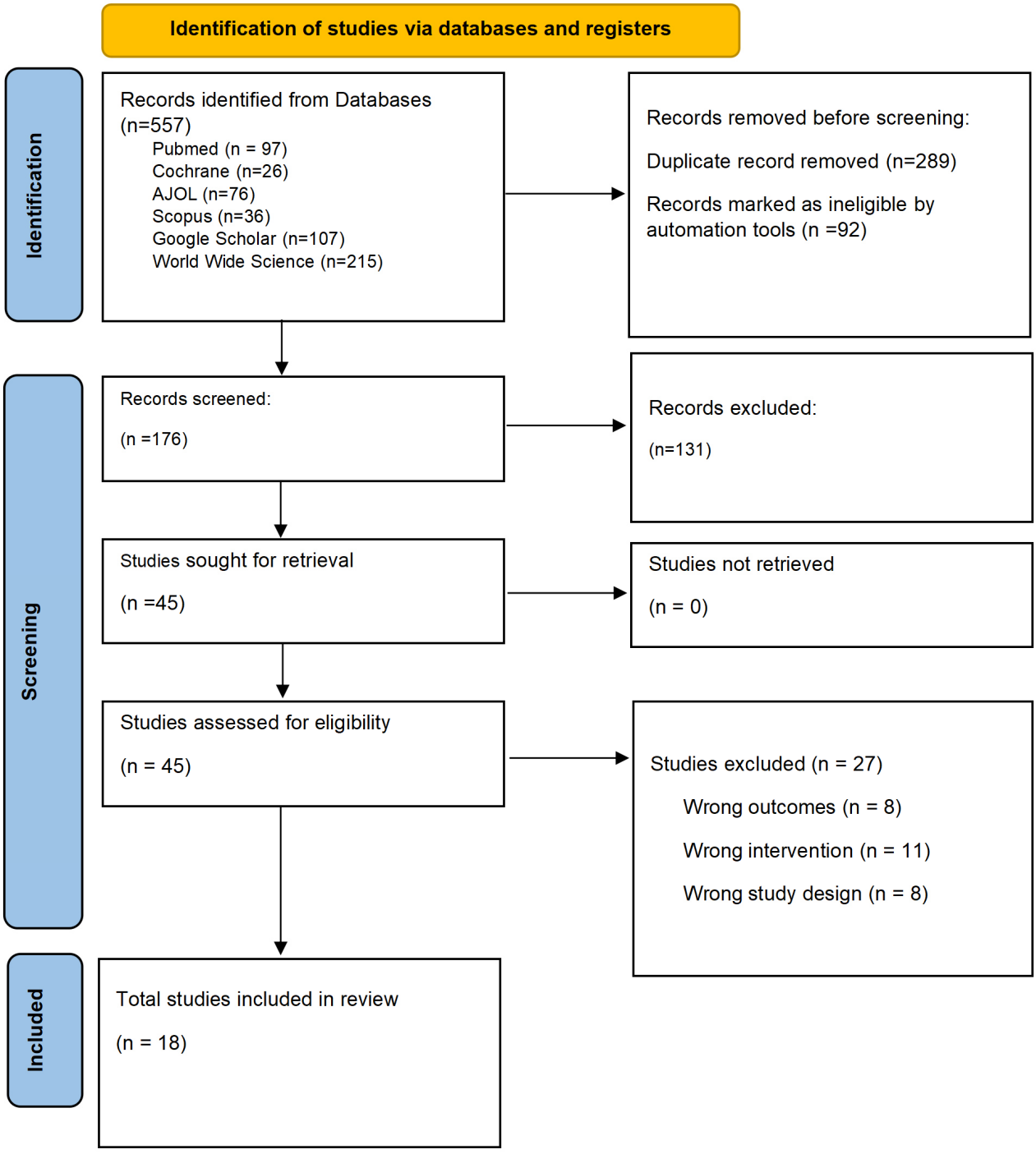

Figure 1: *PRISMA Chart*

Table 1: *Data Extraction Chart*

Study Number	Authors	Year	Study Design	Study Population	Intervention	Outcomes Assessed	Key Findings
1	Karuppiah P, Rajaram S	2012	In vitro, Laboratory Study	Multi-drug resistant bacteria isolates	Garlic and Ginger extracts (ethanol)	Zone of inhibition, Minimum inhibitory concentration (MIC)	Garlic showed a 19.45 mm inhibition zone against *Pseudomonas aeruginosa*, with MIC as low as 67.00 µg/mL. Both garlic and ginger extracts were effective against tested pathogens.
2	Ameri A, Farashahinejad M, Davoodian P, *et al.*	2024	Randomized Double-blind RCT	84 outpatients with COVID-19	Ginger (1000 mg, 3 times daily for 7 days)	Viral clearance, oxygen saturation, respiratory rate, adverse events	Ginger had no significant impact on viral clearance but reduced pulmonary infiltrate and improved oxygen saturation.
3	Elango A, Rao LN, Sugumar P, Radhakrishnan A	2022	Randomized Controlled Trial	50 participants with uncomplicated RTIs	Nigella sativa oil (1000 mg twice daily) plus standard treatment	Symptom relief, adverse events	Nigella sativa added to standard treatment showed early symptom relief and a similar safety profile compared to the standard treatment group.
4	Manshoor N, Simmonds M	2025	Ethnobotanical Survey	General population of Cameroon	Traditional plant-based remedies, e.g., *Zingiber officinale*, *Ocimum gratissimum*	Anti-inflammatory, decongestant, antimicrobial activities	Identified several bioactive compounds (eucalyptol, menthol, gingerol) with strong anti-inflammatory and antimicrobial properties for RTI treatment.
5	Alemseged M, Adugna S, Bayu E	2018	Laboratory Study	Respiratory infection bacteria	Honey and Garlic extracts mixture	Zone of inhibition, MIC, bactericidal activity	Honey and garlic mixture showed greater inhibition than standard antibiotics like Co-trimoxazole and Cefoxitin, against respiratory pathogens.
6	Mshelia BM, Adeshina GO, Onaolapo JA	2018	Comparative Study	*Staphylococcus aureus* isolates from RTIs	Honey, Lemon, and their combination with standard antibiotics	Zone of inhibition, bactericidal activity	Honey and lemon mixture exhibited superior antibacterial activity against *S. aureus* compared to individual treatments and antibiotics.
7	Elango A, Rao LN, Sugumar P, Radhakrishnan A	2022	Randomized Controlled Trial	50 participants with uncomplicated RTIs	Nigella Sativa oil with standard treatment	Symptom relief, adverse events	Group with Nigella sativa + standard treatment showed early symptom improvement; minor adverse events in both groups.

Study Number	Authors	Year	Study Design	Study Population	Intervention	Outcomes Assessed	Key Findings
8	Kumar RA, Kumar RM, Duraivel M, Basha AA, Stanley VA, Ruckmani A	2021	Randomized Controlled Trial	60 patients with uncomplicated RTIs	Siddha Polyherbal formulation (ViproTM)	Symptom severity, adverse events	ViproTM demonstrated efficacy similar to standard treatment for managing uncomplicated respiratory infections; minor adverse events.
9	Ngotta Biyon J, Doumbe Makembe L, Nnanga Jeanne F, et al.	2022	Ethnobotanical Survey	115 participants from peri-urban and rural areas in Cameroon	*Zingiber officinale*, *Citrus limon*, and other local plants	Frequency of citation, plant part usage, preparation methods	High frequency of use for *Zingiber officinale* and *Citrus limon* for respiratory infections; common preparation methods were decoction and infusion.
10	Cineha B, Kalaivani P	2023	Comparative Laboratory Study	*Staphylococcus aureus* isolates from RTIs	Garlic and Ginger extracts (aqueous, methanolic)	Zone of inhibition, antimicrobial activity	Garlic showed a higher zone of inhibition than ginger, particularly in methanolic extract, against *S. aureus*.
11	Adeshina GO, Mshelia BM, Onaolapo JA	2013	Laboratory Study	*Klebsiella pneumoniae* isolates from RTIs	Honey, Lemon, and their mixture with standard antibiotics	Zone of inhibition, MIC, bactericidal activity	Honey and lemon showed effective antibacterial activity against *Klebsiella pneumoniae*, with better bactericidal effects than honey alone.
12	Mshelia BM, Adeshina GO, Onaolapo JA	2017	Laboratory Study	*Streptococcus pneumoniae* and *S. pyogenes*	Honey, Lemon, and their mixture with standard antibiotics	Zone of inhibition, bactericidal activity	Honey/lemon mixture showed excellent bactericidal activity compared to individual agents and antibiotics, particularly against *S. pneumoniae* and *S. pyogenes*.
13	Abuelgasim H, Albury C, Lee J, Lee J	2020	Systematic Review & Meta-Analysis	Studies on honey for upper respiratory tract infections (URTIs)	Honey (various doses)	Symptom relief, cough frequency and severity	Honey was superior to usual care for improving symptoms, including reducing cough frequency and severity in children with URTIs.
14	Aldebaran de Villasante Llaquet I	2025	Clinical Study	130 participants with mild to moderate RTIs	Honey and Lemon mixture (gargle treatment)	Symptom relief, pain, inflammation, recovery time	Honey and lemon mixture significantly reduced pain and inflammation in RTI patients, with faster symptom relief compared to conventional treatments.

Study Number	Authors	Year	Study Design	Study Population	Intervention	Outcomes Assessed	Key Findings
15	Kumar S, Verma M, Hajam YA, Kumar R	2023	Review Article	Pathological diseases treated with honey and herbs	Honey infused with herbs (various combinations)	Therapeutic uses, efficacy	Honey with herbs showed potential therapeutic benefits for treating diseases like cold, cough, and other infections through its antibacterial, antiviral, and antioxidant properties.
16	Odebunmi CA, Adetunji TL, Adetunji AE, *et al*.	2022	Ethnobotanical Survey	56 participants from Ogbomosho, Nigeria	*Zingiber officinale*, *Citrus limon*, and other local plants	Frequency of citation, plant parts used	Most cited plants for RTIs were *Zingiber officinale* (COVID-19) and *Citrus limon* (cough); leaves and barks used in decoctions and infusions.
17	Townsend EA, Siviski ME, Zhang Y, Xu C, Hoonjan B, Emala CW	2012	Laboratory Study	Guinea pig and human airway smooth muscle	Ginger and its active components ([6]-gingerol, [8]-gingerol, [6]-shogaol)	Airway smooth muscle relaxation, calcium regulation	Ginger and its components induced smooth muscle relaxation and attenuated airway hyperresponsiveness through modulation of intracellular calcium.
18	Oduwole O, Udoh EE, Oyo-Ita A, Meremikwu MM	2018	Systematic Review	Children with acute cough	Honey (various doses)	Cough frequency, symptom relief, adverse events	Honey reduced cough frequency better than placebo and dextromethorphan in children, with minor adverse events reported.