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RESEARCH ARTICLE

Environmental Parameters and Beyond: Exploring Salts, Oils, Plant Extracts, and Honey against COVID-19

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Abstract

The COVID-19 pandemic has prompted the exploration of various therapeutic approaches, including the use of natural products traditionally known for their medicinal properties. This review examines the potential roles of salts, essential oils, plant extracts, and honey as adjunctive treatments for COVID-19. Each of these natural therapies offers unique benefits, ranging from antiviral and anti-inflammatory effects to immune modulation and symptomatic relief. The review highlights key mechanisms of action, including the ability of hypertonic saline to enhance mucociliary clearance, the antiviral properties of essential oils, the broad-spectrum activity of plant extracts, and the immunomodulatory effects of honey. Despite promising in vitro and preliminary clinical evidence, the integration of these natural therapies into conventional treatment protocols faces challenges such as variability in composition, the need for standardization, and a lack of large-scale clinical trials. Addressing these challenges through further research and standardization efforts is essential to fully realize the potential of these therapies. Ultimately, this review underscores the importance of a holistic, integrative approach to COVID-19 treatment, combining the best of conventional medicine with evidence-based natural therapies to improve patient outcomes and public health.

Keywords: Salts | SARS-CoV-2 | COVID-19 | Oils | Plant Extracts | Honey

Significance

This study examines the potential of natural therapies, salts, essential oils, plant extracts, and honey, as adjunctive treatments for COVID-19. It highlights their antiviral, anti-inflammatory, and immune-modulating effects. Despite promising preliminary evidence, challenges like composition variability and lack of large-scale trials limit their integration into standard treatments. A holistic, integrative approach combining conventional and natural therapies is recommended for better patient outcomes.

Introduction

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has resulted in an unprecedented global health crisis, leading to millions of deaths and widespread socioeconomic disruption (1-4). Since its emergence in late 2019, COVID-19 has challenged healthcare systems worldwide, highlighting the urgent need for effective treatments and preventive measures (5-9). The rapid spread of the virus, coupled with the high mortality rate among vulnerable populations, has driven intense research efforts to identify therapeutic strategies that can mitigate the impact of the disease (10). While vaccines have been developed and deployed with remarkable speed, and antiviral drugs such as remdesivir and monoclonal antibodies have shown efficacy in certain cases, the search for effective treatments continues, especially for those unable to access or respond adequately to these interventions (4, 5, 11, 12). The complexity of the disease, which can range from mild respiratory symptoms to severe acute respiratory distress syndrome (ARDS) and multisystem organ failure, underscores the need for a multifaceted approach to treatment (13). As the virus continues to evolve, there is a growing interest in exploring alternative therapies that can complement existing treatments. Among these, natural products such as salts, essential oils, plant extracts, and honey have attracted attention due to their historical use in treating respiratory infections, their broad-spectrum antimicrobial properties, and their potential to enhance the immune response (14). The therapeutic properties of natural salts, oils, plant extracts, and honey have been well-documented in traditional medicine and supported by modern scientific research (15).

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This review aims to critically assess the potential role of salts, oils, plant extracts, and honey in the management of COVID-19. We will explore the mechanisms by which these natural products may exert antiviral effects, their efficacy in clinical settings, and their potential to be integrated into existing treatment protocols.

Role of Salts in COVID-19 Treatment

Salts, particularly in the form of saline solutions, have been used for centuries as a therapeutic agent in respiratory infections (16). The use of saline, especially hypertonic saline, in nasal irrigation and inhalation therapy is well-documented in medical literature. The practice of saline gargling and nasal irrigation (also known as nasal lavage) has been a part of traditional medicine in various cultures for managing colds, flu, and other upper respiratory tract infections (17).

The therapeutic benefits of hypertonic saline stem from its ability to draw out excess fluid from inflamed tissues, reduce edema, and enhance mucociliary clearance. By promoting the removal of mucus and pathogens from the nasal passages and respiratory tract, saline solutions help alleviate symptoms and reduce the risk of secondary infections (18).

The effectiveness of saline solutions in treating respiratory infections, including COVID-19, can be attributed to several mechanisms. Hypertonic saline creates an osmotic gradient that draws water out of swollen airway tissues. This reduction in tissue edema helps to open up the airways, making it easier to breathe (19). Additionally, the osmotic effect facilitates the clearance of mucus, which can trap viruses and other pathogens. The cilia lining the respiratory tract play a crucial role in clearing mucus and trapped particles, including pathogens. Hypertonic saline enhances the ciliary beat frequency, thereby improving mucociliary clearance and reducing the likelihood of pathogen colonization (18, 19). While the primary action of saline is mechanical, there is evidence to suggest that hypertonic saline may directly affect viral particles. The high salt concentration can disrupt the lipid envelope of viruses, including coronaviruses, rendering them less infectious. By clearing mucus and debris from the nasal passages and respiratory tract, saline irrigation can potentially reduce the viral load, thereby lowering the risk of transmission and reducing the severity of the infection (19).

Numerous studies have explored the use of saline solutions in respiratory infections, with a growing body of evidence supporting their use in the management of COVID-19. A randomized controlled trial published in the Journal of Respiratory Medicine examined the effects of hypertonic saline nasal irrigation in patients with mild to moderate COVID-19 symptoms (20). The study found that patients who performed regular saline irrigation showed a significant reduction in viral load in the nasal passages compared to those who did not use saline. Additionally, the group using saline reported faster resolution of symptoms such as nasal congestion, sore throat, and cough. The authors concluded that saline irrigation could be a useful adjunct therapy in reducing the severity and duration of COVID-19 symptoms (20). A meta-analysis published in the International Journal of Clinical Practice reviewed multiple studies on the use of saline gargling and nasal irrigation in viral respiratory infections, including studies conducted during the early stages of the COVID-19 pandemic (21). The analysis found consistent evidence that saline solutions were effective in reducing symptoms and improving patient outcomes. The authors noted that while saline is not a cure for viral infections, it is a low-cost, low-risk intervention that can provide symptomatic relief and possibly reduce transmission rates (21). A study published in the American Journal of Respiratory and Critical Care Medicine focused on the role of mucociliary clearance in COVID-19 and the potential benefits of hypertonic saline (22). The researchers emphasized that enhanced mucociliary clearance is crucial in preventing the accumulation of mucus and pathogens in the respiratory tract, which can lead to complications such as secondary bacterial infections. The study supported the use of hypertonic saline as part of a broader strategy to maintain respiratory health in COVID-19 patients (22). A more recent pilot study published in Frontiers in Pharmacology investigated the use of hypertonic saline in a small cohort of COVID-19 patients (23). The study aimed to assess the safety and efficacy of saline nasal irrigation and inhalation in reducing the severity of respiratory symptoms. The findings indicated that patients who used hypertonic saline experienced less severe symptoms, shorter duration of illness, and a lower need for additional medical interventions. The authors called for larger, more comprehensive studies to confirm these preliminary results (23).

While the use of hypertonic saline in COVID-19 treatment shows promise, there are several challenges and considerations that need to be addressed. One of the key challenges is the lack of standardized protocols for the use of saline solutions in COVID-19 treatment. Variations in the concentration of saline, frequency of use, and method of administration (e.g., nasal irrigation vs. inhalation) can lead to inconsistent outcomes (24). Future research should focus on establishing clear guidelines for the use of saline in different stages of COVID-19. Another challenge is ensuring patient compliance with saline irrigation and inhalation regimens (25). Some patients may find the practice uncomfortable or difficult to maintain, particularly if they are experiencing severe symptoms. Education and support are essential to encourage adherence to saline therapy. It is important to emphasize that hypertonic saline is not a standalone treatment for COVID-19. While it can provide symptomatic relief and potentially reduce viral load, it should be used in conjunction with other therapies, including antiviral drugs, corticosteroids, and supportive care. Future studies should explore the potential of combining hypertonic saline with other treatments, such as antiviral agents or immunomodulators, to enhance its efficacy. Additionally, research should investigate the long-term effects of saline use, particularly in patients with chronic respiratory conditions who may be at higher risk of severe COVID-19 (26).

Hypertonic saline solutions offer a promising, low-cost adjunct therapy for the management of COVID-19. By enhancing mucociliary clearance, reducing inflammation, and potentially lowering viral load, saline solutions can contribute to the overall treatment strategy for COVID-19. However, further research is needed to standardize protocols, improve patient compliance, and fully understand the role of saline in the broader context of COVID-19 treatment.

Role of Oils in COVID-19 Treatment

Essential oils, which are concentrated extracts derived from plants, have been used for centuries in traditional medicine across various cultures. These oils are known for their antimicrobial, anti-inflammatory, and antiviral properties (27). Historically, essential oils such as eucalyptus, tea tree, peppermint, and thyme have been used to treat respiratory conditions like colds, influenza, bronchitis, and pneumonia (28, 29). Their use has been largely driven by their ability to alleviate symptoms such as congestion, cough, and sore throat, as well as their potential to inhibit the growth of pathogens (28, 29).

Essential oils are typically administered through inhalation, topical application, or as part of aromatherapy (30). Inhalation of steam infused with essential oils is a common practice for relieving respiratory symptoms, and this method has been adopted in various forms around the world (31).

The therapeutic effects of essential oils in the context of respiratory infections, including COVID-19, can be attributed to several bioactive compounds found in these oils. These compounds, including terpenes, phenolics, and aldehydes, exert a range of biological activities that can be beneficial in managing viral infections (32). Many essential oils possess compounds that have been shown to disrupt viral envelopes, inhibit viral replication, and interfere with the attachment of viruses to host cells. For instance, eucalyptol (1,8-cineole), a major component of eucalyptus oil, has been reported to exhibit antiviral activity by disrupting the lipid membranes of viruses (33). Essential oils can modulate the inflammatory response by inhibiting the production of pro-inflammatory cytokines. This is particularly relevant in the context of COVID-19, where severe disease is often associated with an overactive immune response, leading to cytokine storm and tissue damage (34). Some essential oils can enhance the immune response by stimulating the activity of immune cells such as macrophages and natural killer cells. For example, tea tree oil has been shown to enhance the phagocytic activity of macrophages, thereby boosting the body's ability to fight off infections (35). Inhalation of essential oils can provide immediate relief from respiratory symptoms by opening up the airways, reducing mucus production, and alleviating cough. The soothing effects of oils like peppermint and lavender can also help reduce stress and anxiety, which are common in patients with respiratory infections (36).

A growing body of research has explored the potential of essential oils in the treatment of viral respiratory infections, including COVID-19. Below are some key studies and clinical evidence that highlight the role of essential oils in this context. A study published in Phytotherapy Research investigated the antiviral properties of eucalyptus oil against respiratory viruses, including SARS-CoV-2. The researchers found that eucalyptol, the main active component of eucalyptus oil, exhibited significant antiviral activity in vitro by disrupting the lipid envelope of the virus. Additionally, the inhalation of eucalyptus oil was found to reduce symptoms such as nasal congestion and cough in patients with mild respiratory infections. The study concluded that eucalyptus oil could be a valuable adjunct therapy in managing COVID-19 symptoms, particularly in the early stages of the disease (37). A study published in Journal of Infectious Diseases explored the antiviral effects of tea tree oil against coronaviruses (38). The researchers conducted in vitro experiments showing that tea tree oil inhibited the replication of SARS-CoV-2 by disrupting the viral envelope and inhibiting viral RNA synthesis (38). The study also noted that tea tree oil exhibited anti-inflammatory effects, which could help mitigate the hyperinflammatory response associated with severe COVID-19. The authors suggested that tea tree oil could be used as a topical or inhalation therapy to reduce viral load and inflammation in COVID-19 patients (38). A study published in Journal of Alternative and Complementary Medicine focused on the use of lavender oil in reducing anxiety and improving sleep quality in COVID-19 patients (39). The study found that aromatherapy with lavender oil significantly reduced anxiety levels and improved sleep quality in hospitalized COVID-19 patients. The calming effects of lavender oil were attributed to its ability to modulate the activity of the autonomic nervous system, reducing stress-related symptoms that can exacerbate respiratory conditions (39). A more recent study published in Frontiers in Pharmacology examined the antiviral effects of oregano oil, which contains high levels of carvacrol, against SARS-CoV-2 (40). The study demonstrated that carvacrol exhibited strong antiviral activity by inhibiting the protease enzymes essential for viral replication. Additionally, oregano oil was found to reduce the expression of pro-inflammatory cytokines in infected cells, suggesting a dual role in antiviral defense and inflammation control (40). The researchers highlighted the potential of oregano oil as a complementary therapy for managing COVID-19, especially in combination with other antiviral agents (40). While essential oils offer promising therapeutic benefits, there are several challenges and considerations that need to be addressed to fully integrate them into COVID-19 treatment protocols. The composition of essential oils can vary significantly depending on factors such as the plant species, geographic origin, and extraction method (41). This variability can lead to inconsistent therapeutic outcomes, making it difficult to standardize essential oil-based treatments (41). Future research should focus on identifying and standardizing the key bioactive components responsible for the antiviral effects of specific oils. Although essential oils are generally considered safe when used appropriately, there is a risk of adverse effects, particularly when oils are ingested or applied in high concentrations. Some essential oils can cause skin irritation, allergic reactions, or respiratory distress if not properly diluted. Clinical studies should establish safe dosage ranges and guidelines for the use of essential oils, particularly in vulnerable populations such as the elderly and those with pre-existing respiratory conditions (42). Despite the promising in vitro and preliminary clinical studies, there is a lack of large-scale, randomized controlled trials (RCTs) evaluating the efficacy of essential oils in COVID-19 treatment. Such trials are needed to provide robust evidence of their therapeutic potential and to establish clear guidelines for their use in clinical practice (43). The regulatory landscape for essential oils varies widely across different regions. In some countries, essential oils are classified as dietary supplements or cosmetics, rather than medicinal products, which limits the scope of clinical research and application (44) . Efforts should be made to harmonize regulations and encourage the inclusion of essential oils in therapeutic guidelines based on scientific evidence. Essential oils should be viewed as complementary, rather than alternative, therapies for COVID-19. Their integration into existing treatment protocols requires careful consideration of potential interactions with conventional antiviral drugs and other medications. Future research should explore synergistic effects between essential oils and established COVID-19 treatments to maximize therapeutic efficacy.

Essential oils, with their diverse biological activities, offer a promising adjunctive approach to the treatment of COVID-19. Their antiviral, anti-inflammatory, and immunomodulatory properties, coupled with their ability to provide symptomatic relief, make them valuable tools in managing respiratory infections. However, further research is needed to standardize their use, ensure safety, and validate their efficacy through large-scale clinical trials. By addressing these challenges, essential oils could play a significant role in the holistic management of COVID-19 and other viral respiratory diseases.

Role of Plant Extracts in COVID-19 Treatment

Plants have been a cornerstone of traditional medicine for millennia, with various cultures utilizing plant extracts to treat respiratory infections and other ailments. The use of plant-based remedies dates back to ancient civilizations, where herbal medicines were commonly used to alleviate symptoms of colds, influenza, and other respiratory conditions (45). Plants like licorice, turmeric, neem, and elderberry have been particularly noted for their therapeutic properties. Historically, plant extracts were used for their antimicrobial, anti-inflammatory, and immune-boosting properties (46). The active compounds in these plants, known as phytochemicals, include flavonoids, alkaloids, terpenoids, and polyphenols, which have been shown to exhibit a wide range of biological activities (47). The integration of plant extracts into modern medicine has been driven by the growing interest in natural products as potential

sources of new therapeutic agents (47).

The therapeutic effects of plant extracts in the context of COVID-19 and other viral respiratory infections are primarily attributed to their bioactive compounds, which can exert antiviral, anti-inflammatory, and immunomodulatory effects (47, 48). The following mechanisms highlight how plant extracts may contribute to the treatment of COVID-19. Many plant extracts contain compounds that can inhibit the replication of viruses, including SARS-CoV-2. For instance, flavonoids and alkaloids have been shown to interfere with viral entry into host cells, inhibit viral enzymes, and prevent the assembly and release of new viral particles (48). Certain phytochemicals can also disrupt the viral envelope, making the virus less infectious. Severe COVID-19 is often characterized by an excessive inflammatory response, known as a cytokine storm, which can lead to tissue damage and organ failure. Plant extracts rich in anti-inflammatory compounds, such as curcumin from turmeric and quercetin from various fruits and vegetables, can modulate the immune response by inhibiting the production of pro-inflammatory cytokines and promoting the release of anti-inflammatory mediators (49). Some plant extracts can enhance the body's immune response, thereby increasing resistance to viral infections. For example, polysaccharides found in medicinal mushrooms and certain herbs can stimulate the activity of immune cells like macrophages, natural killer cells, and T-lymphocytes, which are crucial for viral clearance (50). Oxidative stress plays a significant role in the pathogenesis of viral infections, including COVID-19. Plant extracts that are rich in antioxidants can neutralize free radicals and reduce oxidative damage, thereby protecting tissues and supporting overall health (51).

The potential of plant extracts in the treatment of COVID-19 has been explored in numerous studies, ranging from in vitro experiments to clinical trials. Here, we present key studies that highlight the therapeutic benefits of various plant extracts in the context of COVID-19. A study published in Frontiers in Pharmacology examined the antiviral and anti-inflammatory properties of curcumin, the active compound in turmeric (Curcuma longa), against SARS-CoV-2 (52). The researchers found that curcumin inhibited the replication of the virus in vitro by targeting multiple stages of the viral life cycle. Additionally, curcumin demonstrated significant anti-inflammatory effects by downregulating the expression of pro-inflammatory cytokines such as IL-6 and TNF-α. The study concluded that curcumin could be a promising adjunct therapy for reducing the severity of COVID-19 and preventing complications related to cytokine storm (52). A review published in Molecules highlighted quercetin, a flavonoid found in many fruits and vegetables, as a broad-spectrum antiviral agent with potential against SARS-CoV-2 (53). Quercetin was shown to inhibit viral entry by blocking the interaction between the spike protein of the virus and the ACE2 receptor on host cells. Additionally, quercetin exhibited anti-inflammatory and antioxidant properties, which could help mitigate the inflammatory response associated with severe COVID-19. The review suggested that quercetin, due to its multi-targeted mechanism of action, could be an effective component of a preventive or therapeutic strategy against COVID-19 (53). A more recent study published in Journal of Ethnopharmacology focused on the antiviral potential of neem (Azadirachta indica) extracts against SARS-CoV-2 (54). The study utilized both in vitro and in silico approaches to demonstrate that neem extracts, particularly those containing azadirachtin and nimbolide, could inhibit the main protease (Mpro) of the virus, which is essential for viral replication. Additionally, neem extracts were found to enhance the production of interferons, which are critical for the antiviral immune response. The researchers proposed that neem could be explored further as a natural antiviral agent with potential applications in COVID-19 therapy (54). A study published in Journal of Advanced Research investigated the antiviral activity of glycyrrhizin, a triterpenoid saponin found in licorice root (Glycyrrhiza glabra), against SARS-CoV-2 (55). The study demonstrated that glycyrrhizin inhibited viral replication by interfering with the viral attachment and entry process. Additionally, glycyrrhizin showed potent anti-inflammatory effects by suppressing the production of pro-inflammatory cytokines. The authors concluded that licorice root extract, and specifically glycyrrhizin, could be a valuable therapeutic option for managing COVID-19 symptoms and preventing severe disease progression (55). A study published in Phytotherapy Research explored the use of elderberry (Sambucus nigra) extract as a supportive treatment for COVID-19 (56). Elderberry has long been used in traditional medicine for its antiviral and immune-boosting properties. The study found that elderberry extract exhibited significant antiviral activity against SARS-CoV-2 in vitro by inhibiting viral replication and modulating the immune response. The researchers also noted that elderberry could reduce the severity and duration of symptoms in patients with mild to moderate COVID-19 (56). The study suggested that elderberry could be considered as part of an integrative approach to COVID-19 treatment.

While the potential of plant extracts in COVID-19 treatment is promising, several challenges must be addressed to fully realize their therapeutic benefits. One of the primary challenges in the use of plant extracts is the variability in the composition of bioactive compounds. Factors such as plant species, growing conditions, and extraction methods can lead to significant differences in the potency and efficacy of plant extracts (57). Standardization of extracts is essential to ensure consistent therapeutic outcomes and to facilitate their integration into clinical practice. The bioavailability of many phytochemicals is limited due to poor absorption, rapid metabolism, and low solubility (58). Enhancing the bioavailability of these compounds through the use of novel delivery systems, such as nanoparticles or liposomes, could improve their therapeutic efficacy. Further research is needed to understand the pharmacokinetics of these compounds in humans and to develop formulations that maximize their bioavailability. Although plant extracts are generally considered safe, there is a risk of adverse effects, particularly when used in high doses or over prolonged periods (59). Some phytochemicals can interact with conventional medications, leading to potential drug-herb interactions. It is crucial to establish safe dosage ranges and to monitor patients for any adverse effects when using plant extracts as part of COVID-19 treatment (59). While preclinical studies and small-scale clinical trials have shown promising results, there is a need for large-scale, randomized controlled trials (RCTs) to validate the efficacy and safety of plant extracts in the treatment of COVID-19 (60). Such trials are essential to provide robust evidence and to inform clinical guidelines for the use of these natural products in COVID-19 management (60). Plant extracts should be considered as complementary therapies

rather than standalone treatments (61). Their integration into conventional treatment protocols requires a thorough understanding of their mechanisms of action and potential interactions with other medications. Research should focus on identifying synergistic effects between plant extracts and conventional antiviral drugs to enhance overall treatment outcomes (61).

Plant extracts, with their rich array of bioactive compounds, offer a promising adjunctive approach to the treatment of COVID-19. Their antiviral, anti-inflammatory, and immunomodulatory properties make them valuable candidates for supporting the management of viral respiratory infections. However, challenges such as standardization, bioavailability, safety, and the need for rigorous clinical trials must be addressed to fully harness their therapeutic potential. Continued research and clinical validation are essential to integrate plant extracts into evidence-based treatment strategies for COVID-19 and beyond.

Role of Honey in COVID-19 Treatment

Honey has been used for medicinal purposes for thousands of years, with its application in treating wounds, infections, and various ailments documented in ancient Egyptian, Greek, and Roman texts (62). Known for its antimicrobial properties, honey has played a vital role in traditional medicine systems, including Ayurveda and traditional Chinese medicine. The use of honey in respiratory ailments, such as coughs, colds, and bronchitis, is well-documented, with honey often being combined with other herbal remedies to enhance its therapeutic effects (62). The medicinal properties of honey are largely attributed to its high sugar content, low pH, and the presence of bioactive compounds such as hydrogen peroxide, flavonoids, and phenolic acids. These components contribute to honey's ability to inhibit the growth of a wide range of pathogens, including bacteria, fungi, and viruses (63).

Honey exhibits antiviral properties that can inhibit the replication of viruses and prevent their attachment to host cells (64). The presence of bioactive compounds such as flavonoids and phenolic acids in honey contributes to its ability to neutralize viruses. Additionally, the high osmolarity of honey, due to its sugar content, can create an environment that is hostile to viral survival (64). Honey has well-documented anti-inflammatory properties, which are crucial in the management of respiratory infections (65). In COVID-19, where an excessive inflammatory response, known as a cytokine storm, can lead to severe complications, honey's ability to modulate inflammation could be beneficial. Honey reduces inflammation by inhibiting the production of pro-inflammatory cytokines and promoting the release of anti-inflammatory mediators (65).

Honey can enhance the immune response, which is critical in fighting off infections like COVID-19 (63). The immunomodulatory effects of honey include the activation of immune cells such as macrophages and T-lymphocytes, as well as the promotion of antibody production. These effects help in enhancing the body's defense mechanisms against viral infections (63). Oxidative stress plays a significant role in the pathogenesis of COVID-19, particularly in severe cases where tissue damage occurs due to an excessive release of reactive oxygen species (ROS) (66). Honey, rich in antioxidants like flavonoids and phenolic acids, can neutralize ROS, thereby protecting tissues from oxidative damage and supporting overall recovery (66). In addition to its systemic effects, honey is known for its wound healing properties, which can be beneficial in managing complications related to COVID-19, such as secondary bacterial infections and respiratory tissue damage. The application of honey to wounds accelerates healing by promoting tissue regeneration, reducing inflammation, and preventing infection (66).

Several studies have investigated the potential role of honey in managing respiratory infections, including its application in the treatment of COVID-19. Here, we present key studies that highlight the therapeutic benefits of honey in this context. A study published in Frontiers in Microbiology explored the antiviral activity of Manuka honey, a type of honey derived from the nectar of the Manuka tree (Leptospermum scoparium) native to New Zealand (67). The study found that Manuka honey exhibited significant antiviral activity against influenza viruses and herpes simplex viruses, and suggested that similar mechanisms could be effective against SARS-CoV-2. The researchers demonstrated that Manuka honey could inhibit viral replication and reduce the infectivity of viruses in vitro. The study highlighted the potential of Manuka honey as a natural antiviral agent that could complement existing COVID-19 therapies (67). A clinical trial published in Journal of Complementary and Integrative Medicine evaluated the efficacy of honey as an adjunct therapy in COVID-19 patients (68). The trial involved 100 patients with mild to moderate COVID-19 symptoms, who were divided into two groups: one receiving standard care and the other receiving standard care plus daily doses of honey. The results showed that the group receiving honey experienced faster resolution of symptoms, such as cough, sore throat, and fatigue, compared to the control group. Additionally, the honey group had a lower incidence of complications and a shorter duration of hospitalization. The authors concluded that honey could be a valuable supportive treatment in the management of COVID-19 (68). A study published in Nutrients examined the immunomodulatory effects of honey in the context of COVID-19 (69). The researchers focused on honey's ability to modulate the immune response by enhancing the activity of immune cells and reducing the production of pro-inflammatory cytokines. The study found that honey could help prevent the progression of mild COVID-19 to more severe forms by modulating the immune response and preventing excessive inflammation. The authors suggested that honey could be used as a preventive measure or as part of a therapeutic regimen to enhance immune function in COVID-19 patients (69). A systematic review published in Journal of Medicinal Food analyzed multiple studies on the use of honey in treating respiratory infections, including its potential application in COVID-19 (70). The review found consistent evidence supporting honey's efficacy in reducing the severity and duration of symptoms in respiratory infections, such as cough, sore throat, and congestion. The review also highlighted honey's role in reducing the risk of secondary bacterial infections, which are a common complication in viral respiratory illnesses. The authors concluded that honey, due to its broad-spectrum antimicrobial and anti-inflammatory properties, could be a beneficial adjunct therapy in the management of COVID-19 (70).

While honey shows great promise as a supportive treatment for COVID-19, several challenges and considerations must be addressed to fully integrate it into clinical practice:

The composition of honey varies significantly depending on factors such as the floral source, geographic location, and processing methods (71). This variability can affect the therapeutic efficacy of honey, making it challenging to standardize its use in clinical settings. Research should focus on identifying the key bioactive components responsible for honey's antiviral and anti-inflammatory effects and developing standardized formulations (71). The therapeutic benefits of honey are highly dependent on its purity and quality (72). Adulteration of honey with sugar syrups or other additives can diminish its medicinal properties. Ensuring the purity and quality of honey is crucial for its effective use in treating COVID-19 and other respiratory infections. Regulatory standards should be established to maintain the integrity of medicinal honey products (72). While honey is generally considered safe for most people, the optimal dosage and method of administration for treating COVID-19 are not well-established (73). Research is needed to determine the appropriate dosage that maximizes honey's therapeutic effects without causing adverse effects. Additionally, studies should explore different methods of administration, such as oral consumption, inhalation, or topical application, to determine the most effective approach (73). Although honey is safe for most adults, it should be used with caution in certain populations (74). For example, honey is not recommended for infants under one year of age due to the risk of botulism. Patients with diabetes should also use honey cautiously due to its high sugar content. Clinical guidelines should be developed to ensure the safe use of honey in these and other vulnerable populations (74). While preliminary studies and small-scale clinical trials have shown promising results, large-scale, randomized controlled trials (RCTs) are needed to validate honey's efficacy and safety in the treatment of COVID-19 (75). Such trials would provide robust evidence to inform clinical guidelines and promote the integration of honey into evidence-based treatment protocols for COVID-19 (75). Honey should be considered a complementary therapy rather than a standalone treatment for COVID-19 (76). Its integration into conventional treatment protocols requires a thorough understanding of its interactions with other medications and its role in the overall therapeutic strategy. Future research should explore the potential synergistic effects between honey and conventional antiviral drugs to enhance treatment outcomes (76).

Honey, with its rich array of bioactive compounds, offers a promising adjunctive approach to the treatment of COVID-19. Its antiviral, anti-inflammatory, and immunomodulatory properties, combined with its safety and accessibility, make it a valuable candidate for supporting the management of viral respiratory infections. However, challenges such as standardization, quality control, and the need for rigorous clinical trials must be addressed to fully harness honey's therapeutic potential. Continued research and clinical validation are essential to integrate honey into evidence-based treatment strategies for COVID-19 and beyond.

Conclusion

This review has explored the therapeutic potential of salts, oils, plant extracts, and honey as adjunctive treatments for COVID-19. These natural products, long used in traditional medicine, have demonstrated various beneficial properties, including antiviral, anti-inflammatory, immunomodulatory, and symptomatic relief effects. The evidence presented highlights their potential to complement conventional COVID-19 treatments, offering low-cost, accessible options that may enhance patient outcomes, particularly in managing mild to moderate cases or as supportive therapies. However, the integration of these natural therapies into clinical practice faces several challenges, including variability in composition, the need for standardization, potential safety concerns, and a lack of large-scale, randomized controlled trials (RCTs) that validate their efficacy and safety. Addressing these challenges will require concerted efforts in research, regulation, and clinical practice. Future directions should focus on conducting robust clinical trials to establish the effectiveness of these therapies, exploring their synergistic potential with conventional treatments, and developing standardized formulations to ensure consistent therapeutic outcomes. Additionally, understanding the precise mechanisms of action and potential interactions with other medications will be crucial in safely incorporating these natural products into COVID-19 treatment protocols. While salts, oils, plant extracts, and honey should not be viewed as replacements for conventional COVID-19 therapies, they offer promising complementary approaches that could play a significant role in holistic, integrative medicine. Continued research and clinical validation are essential to fully realize their potential and to integrate these natural therapies into evidence-based strategies for managing COVID-19 and future respiratory pandemics. By embracing both modern medicine and traditional remedies, we can develop more comprehensive, accessible, and effective approaches to improving patient care and public health outcomes.

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