Original Article

Exploring Myrrh Oil as a Natural Antimicrobial Agent Against Oral Pathogens: An *In Vitro* Research

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ABSTRACT

Background: While contemporary pharmaceuticals play a critical role in managing oral infections, there remain persistent concerns regarding their chemical composition and potential adverse effects. This apprehension has led to an increased focus on exploring natural alternatives, particularly herbal substances, for their potential therapeutic benefits in oral health. **Aim:** This study aimed to examine the antibacterial properties of myrrh oil against common oral bacteria, including Candida, Escherichia coli, Klebsiella, and Staphylococcus aureus, and to assess its suitability as a natural alternative in oral healthcare. **Methods:** Oral swabs were obtained from 50 individuals from various socioeconomic backgrounds. The isolated organisms were cultivated on different types of media and identified using established microbiological methods. Bacterial growth inhibition was evaluated by culturing subsequent cultures on Muller-Hinton agar with myrrh oil. This agar medium was selected for its suitability in evaluating myrrh oil's suppressive impact on oral bacteria proliferation. **Results:** Candida demonstrated abundant proliferation on the control media but showed a reduction in colony-forming units when treated with myrrh oil. E. coli, Klebsiella, and Staphylococcus aureus exhibited decreased growth and suppressed colony formation when exposed to myrrh oil. **Conclusion:** These findings indicate that myrrh oil can prevent the growth of oral bacteria, making it a promising natural antibacterial agent for managing oral health. Additional investigations are needed to examine the safety, ideal dosage, and clinical feasibility of this treatment.

KEYWORDS: *Antibacterial effects, Candida, E. coli, myrrh oil, oral pathogens*

INTRODUCTION

The oral cavity contains an intricate community of various bacteria that play a significant role in determining the equilibrium between well-being and illness.[1] Although modern medications are crucial for controlling oral infections, there are ongoing concerns about their chemical composition and adverse consequences.[2] The rising interest in investigating natural alternatives, namely herbal substances, for their possible therapeutic advantages in oral health has been prompted by this concern.[3]

The oral microbiome is a constantly changing community containing a variety of bacteria, fungi, and viruses. This has an impact on both the local and systemic health.[4] Several bacterial species are frequently associated with oral infections, including Candida, Escherichia coli (E. coli), Klebsiella, and Staphylococcus aureus.[5] These organisms present considerable difficulties in clinical environments owing to their high pathogenicity and capacity to induce a range of oral illnesses, including candidiasis and periodontitis.[6]

Herbal materials have attracted interest because of their wide range of bioactive components that may have

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antibacterial effects.[7] Myrrh oil extracted from plants of the genus Commiphora has demonstrated potential owing to its documented antibacterial, antifungal, and anti-inflammatory characteristics.[8] Nevertheless, although anecdotal evidence supports their effectiveness, there is still a lack of scientific validation and understanding of how they specifically combat oral bacteria.[9]

Hence, this study aimed to fill this gap by examining the possible antimicrobial properties of myrrh oil against common oral bacteria, including Candida, Escherichia coli, Klebsiella, and Staphylococcus aureus. This study aimed to examine the effects of myrrh oil on these organisms to contribute to the development of innovative and natural therapies for managing oral health.[10]

Material and Methods

The commercially available strains ATCC 25923 Staphylococcus aureus, SC5314 Candida albicans, and ATCC15224 Escherichia coli were cultured under in vitro conditions described by Anderl *et al*.[11] Briefly, Staphylococcus aureus cultures were grown overnight in tryptic soy broth at 37°C and then diluted in the same medium to an optical density of 0.05 at 600 nm with phosphate buffer (PB; 0.1 M, pH 7.2). This agar medium was selected for its suitability in evaluating the suppressive effect of myrrh oil on oral bacterial proliferation.

Candida albicans strains were cultured overnight in yeast extract/peptone/dextrose (YPD) medium or plated onto YPD agar plates for 48 h at 30°C. Escherichia coli ATCC15224 were grown in liquid nutrient broth medium CM01 (Oxoide, England) (containing (g/l): Lab lemco powder 1 g, NaCl 5 g, peptone 5 g, and yeast extract 2 g). Muller-Hinton agar was selected for its suitability in evaluating myrrh oil's suppressive impact on oral bacteria proliferation.

Conventional microbiological methods were employed for species identification, involving microscopic examination of wet preparations to assess morphological features, such as size, shape, and staining properties. The Gram staining technique facilitated differentiation between Gram-positive and Gram-negative bacteria, aiding initial organism identification.

Biochemical assays such as oxidase and indole tests were performed. The oxidase test confirmed the presence of cytochrome c oxidase, whereas the indole test distinguished the bacterial species based on indole production.

After incubation for 24 h, the bacterial colony proliferation was visually examined and documented. Colony-forming units were assessed to measure organism growth in the presence of myrrh oil compared with control conditions without oil.

This meticulous approach ensured consistent conditions for evaluating the antibacterial properties of myrrh oil against specific oral bacteria, thereby offering crucial insights into its potential medicinal effectiveness.

Results

The experimental data findings provide interesting insights into the influence of myrrh oil on the growth patterns of certain oral bacteria, including Candida, Escherichia coli, Klebsiella, and Staphylococcus aureus. Candida, a prevalent fungal organism linked to oral illnesses, exhibited vigorous proliferation in several culture media when myrrh oil was not present. However, after exposure to myrrh oil on Mueller-Hinton agar, Candida showed a significant decline in growth. The inhibitory was highly substantial, suggesting a potential suppressive function of myrrh oil against Candida. Figures 1–3: E. coli growth inhibition by myrrh oil: E. coli, a common gram-negative bacterium associated with oral and gastrointestinal illnesses, exhibited reduced

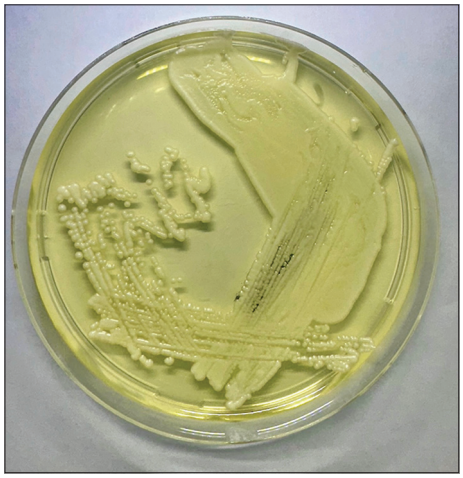

Figure 1: Creamy white colonies of candida

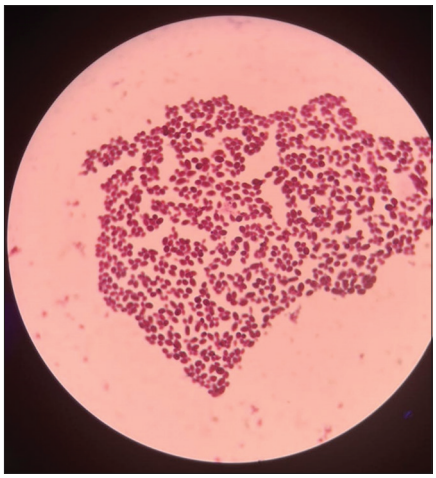

Figure 2: Microscopic picture of candida growth before applying myrrh oil

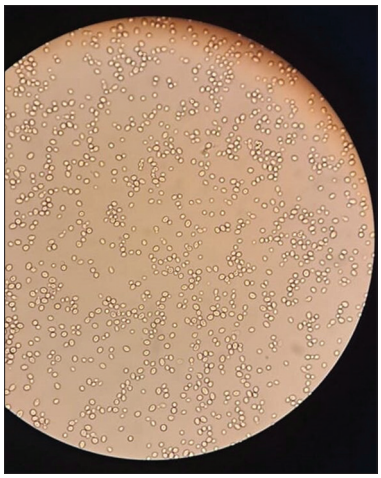

Figure 3: Microscopic picture of candida growth

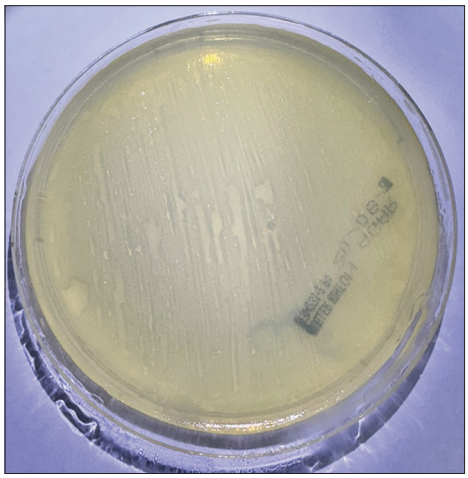

Figure 4: No growth of E. coli after adding myrrh oil

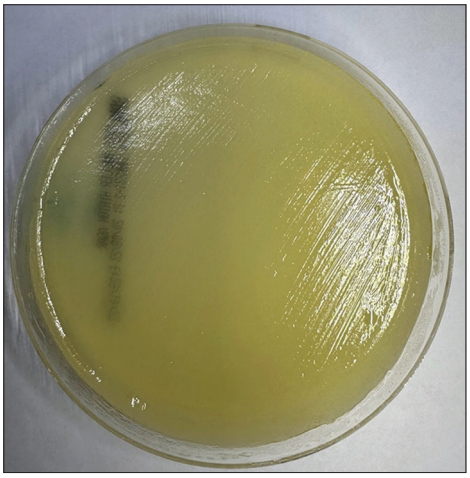

Figure 5: Growth of candida after adding myrrh oil

growth when exposed to media containing myrrh oil in comparison to control conditions. The lack of growth on Sabouraud dextrose agar (SDA) when exposed to myrrh oil indicates a significant inhibitory impact on E. coli.

Figure 4: Impact of myrrh oil on Klebsiella growth: Klebsiella, a Gram-negative bacterium associated with respiratory and urinary tract infections, significantly inhibited growth when cells were exposed to media containing myrrh oil. Lack of growth in Chrome Orientation and SDA provides additional evidence of the inhibitory properties of myrrh oil against Klebsiella. Figure 5: The effect of myrrh oil on Staphylococcus aureus growth was examined. This Gram-positive bacterium, known for causing skin and respiratory infections, showed diminished growth when subjected to myrrh oil in various culture environments. The presence of myrrh oil demonstrated a significant inhibitory effect on Staphylococcus aureus, evidenced by the reduced formation of colonies, especially on Chrome Orientation and SDA media.

Discussion

The results of this study provide some insight into the potential of myrrh oil as a therapeutic agent against Candida, Escherichia coli, Klebsiella, and Staphylococcus aureus. The discovered inhibitory effects and antibacterial characteristics of myrrh oil, signaling its potential application in oral health care should be explored.

There was no considerable growth inhibition of Candida in the presence of myrrh oil, which agrees with earlier research revealing the antifungal action of myrrh extracts against diverse fungal strains.[1] This conclusion is particularly intriguing considering the complexity of controlling Candida-associated oral infections in clinical settings.

Similarly, reduced growth of E. coli, Klebsiella, and Staphylococcus aureus showed broad-spectrum antibacterial activity against myrrh oil. The various reactions of these bacteria to myrrh oil supplementation on different culture media show the complicated interactions between the constituents of the oil and bacterial species, prompting additional inquiry into the exact processes involved.[2]

The observed inhibitory effects are indicative of the involvement of myrrh oil in bacterial growth, potentially affecting crucial cellular processes or structures needed for proliferation. The many bioactive components included in myrrh oil, such as terpenoids and sesquiterpenes, may underlie its antimicrobial activities through various methods, including membrane disruption, enzyme inhibition, and interference with cellular signaling pathways.[3]

De Rapper *et al*.[8] (2012) reported synergistic and additive effects of frankincense and myrrh oils against

various pathogens, including Bacillus cereus, which is relevant given its similarity to oral bacteria.

Comparatively, the current findings are in accordance with earlier studies on the antibacterial properties of natural herbal extracts in oral health care.[4] However, this work adds to the literature by precisely examining the effects of myrrh oil on a spectrum of clinically important oral microorganisms.

Moreover, the observed growth inhibition at rather high concentrations of myrrh oil necessitates further exploration of its efficacy at lower levels to verify its safety and therapeutic range for oral applications.[5] Understanding the appropriate concentration that does not affect the integrity of oral tissue is crucial for clinical translation.

Clinical implications of myrrh oil

The documented suppressive effects of myrrh oil on diverse oral bacteria have substantial implications for its clinical use. If clinical trials confirm its effectiveness, myrrh oil has the potential to be a useful additional or alternative treatment for oral infections. The natural origin and possible effectiveness against many diseases make it a suitable alternative to conventional antimicrobial treatments, particularly for those looking for natural and cost-efficient remedies.[6,7]

Challenges and future directions

The findings underscore the potential antibacterial qualities of myrrh oil but also reveal many obstacles and opportunities for future investigation. It is essential to determine the most effective composition and concentration of myrrh oil for clinical application to maximize its effectiveness and minimize any negative impact on oral tissues. Furthermore, investigating its interactions with other therapies for oral health, such as products containing fluoride or mouthwashes with antibacterial properties, could reveal combined benefits that boost the overall effectiveness.[1,8]

Mechanistic insights and targeted studies

Additional research is necessary to determine the precise processes responsible for the antibacterial properties of myrrh oil. Thorough investigations that clarify how myrrh oil ingredients interact with bacterial targets at the molecular level could reveal important insights, which could then be used to build specific medicines. Furthermore, investigating its capacity to disrupt the production of biofilms or regulate the virulence factors of oral pathogens could offer innovative approaches to combat long-lasting oral infections.[6-9]

When considering natural alternatives such as myrrh oil, it is important to consider factors such as availability, cost, and cultural approval. Assessing the practicality of integrating therapies using myrrh oil into oral health practices among various socioeconomic backgrounds is essential for its general acceptance. Public health initiatives and education programs can work together to close gaps in awareness and encourage educated decisions regarding natural oral health solutions.[3,4-8,12]

The regulatory framework governing herbal treatments requires strict guidelines and standardized methods to ensure quality control and safety. To maintain the dependability and safety of myrrh oil-based oral health products, it is crucial to address concerns regarding product standardization, purity, and compliance with the regulatory criteria.

The limitations of this research include the need for in-depth mechanistic research to understand the precise mechanism of action of myrrh oil on these bacteria. In addition, investigating its efficacy in more complicated oral biofilm models or in vivo situations would provide a fuller understanding of its potential clinical value.

In summary, the consistent pattern seen among various oral bacteria indicates the potential antibacterial effectiveness of myrrh oil. The capacity to hinder or diminish the proliferation of Candida, E. coli, Klebsiella, and Staphylococcus aureus indicates encouraging prospects for the advancement of natural therapies in the treatment of oral infections. Additional investigation into the precise mechanisms that cause these inhibitory effects would improve our comprehension and potential application of myrrh oil in oral healthcare.

Conclusion

This research emphasizes the potential of myrrh oil as a natural alternative with promising antibacterial and antifungal effects against prevalent oral pathogens such as Candida, Escherichia coli, Klebsiella, and Staphylococcus aureus. The observed inhibition and reduction in growth across these bacteria showed the efficiency of myrrh oil in moderating oral microbial proliferation.

The considerable growth inhibition of Candida, along with the lowered growth of E. coli, Klebsiella, and Staphylococcus aureus, demonstrates the broad-spectrum antibacterial activity of myrrh oil. These findings hold substantial significance in resolving issues related to oral infections, especially for individuals seeking natural, non-chemical solutions.

However, further investigations comprising safety assessments, optimal dosage selection, and *in vivo* studies are necessary to establish the clinical application of myrrh oil in oral health care. Exploring its synergistic

effects with conventional medicines and their possible involvement in reducing oral biofilms would offer a full insight into its therapeutic value.

In conclusion, the data presented in this research contribute to the expanding body of evidence supporting myrrh oil as a good candidate for the development of natural therapies for oral health management. Harnessing the potential of myrrh oil could pave the way for novel and sustainable techniques in combating oral infections, catering to varied tastes and demands within healthcare settings.

This research serves as a stepping stone toward harnessing the therapeutic potential of natural treatments, underlining the necessity for additional research to translate these findings into practical and effective oral healthcare solutions.

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Conflicts of interest

There are no conflicts of interest.

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