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Research Article

In-Vitro Assessment Of The Efficacy Of Homeopathic Medicine Of Plant Origin Against Streptococcal Infectious Diseases

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Abstract: This study investigates the in-vitro efficacy of two plant-origin homeopathic medicines, *Psoralea corylifolia* and *Ailanthus grandulosa*, against *Streptococcus mutans*, a bacterium associated with dental caries and various streptococcal infections. As antibiotic resistance continues to rise, alternative treatments such as homeopathy are gaining attention. Both mother tinctures and potentized forms of the remedies (6C, 30C, 200C, 1M, 10M) were tested using the agar well diffusion method to assess their antibacterial activity. The results showed that the mother tinctures of both plants exhibited significant antibacterial effects, with *Psoralea corylifolia* demonstrating a larger zone of inhibition than *Ailanthus grandulosa*. Higher potencies of the remedies showed reduced efficacy, suggesting that lower dilutions or mother tinctures may be more suitable for bacterial infections. While these homeopathic medicines did not surpass the efficacy of conventional antibiotics, they present potential as complementary therapies in addressing antibiotic resistance. The study highlights the need for further research to explore the mechanisms of action and clinical applications of plant-based homeopathic treatments for bacterial infections.

Keywords: Streptococcus, homeopathy, plant-based remedies, in-vitro, antibiotic resistance, *Psoralea corylifolia*, *Ailanthus grandulosa*, alternative medicine, biofilm, immune system.

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INTRODUCTION

The global health community faces an increasing challenge in combating infectious diseases caused by antibiotic-resistant bacteria. Streptococcal infections, particularly those caused by *Streptococcus mutans* and *Streptococcus pyogenes*, represent a significant burden on public health systems worldwide[(1)]. These bacteria are responsible for a range of infections, from pharyngitis (strep throat) to more severe conditions such as rheumatic fever and necrotizing fasciitis. Dental caries, a condition caused primarily by *S. mutans*, affects millions of people globally, leading to tooth decay, pain, and a significant economic burden due to treatment costs[(2)].

Conventional antibiotic treatments have been the first line of defense against streptococcal infections, but the rise of antibiotic resistance has become a critical concern. Over time, bacteria have developed mechanisms to evade the effects of antibiotics, rendering many traditional drugs ineffective. In this context, there is growing interest in alternative and complementary therapies, including homeopathy, which offers a

fundamentally different approach to treating infectious diseases[3].

Homeopathic remedies, particularly those derived from plants, have been used for centuries to treat various health conditions, including bacterial infections. The concept of homeopathy, founded by Samuel Hahnemann in the late 18th century, is based on the principle of "similia similibus curentur" (like cures like), wherein substances that cause symptoms in healthy individuals can be used in diluted forms to treat similar symptoms in sick individuals[4]. This article presents a detailed investigation of the in-vitro efficacy of two plant-based homeopathic medicines, *Psoralea corylifolia* and *Ailanthus grandulosa*, against *Streptococcus mutans*, a key contributor to dental caries and other streptococcal diseases.

This study aims to explore the antibacterial properties of these homeopathic remedies, focusing on the mechanisms of action, their role in combating antibiotic resistance, and their potential applications in modern medicine. The results of this study will contribute to a growing body of literature on alternative treatments for bacterial infections and may offer new insights into the use of homeopathy in clinical settings.

BACKGROUND

1. Streptococcal Infections and Antibiotic Resistance

Streptococcus species are Gram-positive bacteria that are classified based on their hemolytic properties and the composition of their cell walls. The most clinically significant groups include *S. pyogenes* (Group A streptococcus) and *S. mutans*, which are responsible for a wide range of infections in humans. *S. pyogenes* is known for causing conditions such as strep throat, scarlet fever, cellulitis, and necrotizing fasciitis, while *S. mutans* is a major etiological agent in the formation of dental caries[5].

The rise of antibiotic resistance in *Streptococcus* species has become a growing concern, particularly in cases of invasive infections. Over the past few decades, the overuse and misuse of antibiotics have led to the development of resistant strains, making it increasingly difficult to treat common infections[6]. According to the World Health Organization (WHO), antibiotic resistance is one of the biggest threats to global health, food security, and development today. This alarming trend has spurred interest in alternative therapies, including natural and homeopathic remedies that may help reduce the reliance on antibiotics[7].

2. Homeopathy: Principles and Historical Perspective

Homeopathy is a system of alternative medicine that was founded by Samuel Hahnemann in the late 18th century. Its core principle is based on the law of similars, which suggests that substances that produce symptoms in a healthy person can be used in highly diluted forms to treat those same symptoms in a sick individual. Hahnemann's discovery was rooted in his observation that certain drugs, when administered in small doses, could stimulate the body's vital force to restore health. Homeopathy relies on the concept of "potentization," a process in which substances are serially diluted and vigorously shaken to increase their therapeutic potency[8].

Plant-based homeopathic remedies have been used for centuries in the treatment of various diseases. Many plants contain bioactive compounds with antibacterial, antifungal, and anti-inflammatory properties, which have been harnessed in both traditional and modern medicine. In homeopathy, these plant extracts are diluted to minimize toxicity while still maintaining their therapeutic effects[9].

The present study focuses on two such plants: *Psoralea corylifolia* (Babchi) and *Ailanthus grandulosa* (Tree of Heaven). *Psoralea corylifolia* has a long history of use in Ayurvedic and traditional Chinese medicine, where it is employed to treat skin diseases, infections, and inflammatory conditions. It is known for its antibacterial and antifungal properties, which have been documented in both traditional and modern scientific literature. *Ailanthus grandulosa*, on the other hand, has been used in traditional medicine to treat infections, digestive disorders, and respiratory conditions. In homeopathy, both plants are believed to stimulate the immune system and help the body combat infections[10].

3. Relevance of In-Vitro Studies in Homeopathy

In-vitro studies, which are conducted in controlled laboratory environments outside of living organisms, play a crucial role in assessing the efficacy of homeopathic medicines. These studies allow researchers to observe the direct effects of homeopathic preparations on pathogens, such as bacteria and viruses, under controlled conditions. While in-vitro studies do not fully replicate the complexity of the human body, they provide valuable insights into the potential mechanisms of action of homeopathic remedies and their antibacterial properties[11].

In the context of this study, the in-vitro assessment of *Psoralea corylifolia* and *Ailanthus grandulosa* against *Streptococcus mutans* provides an opportunity to explore the antibacterial activity of these remedies and evaluate their potential as alternatives[12,13,14] or adjuncts to conventional antibiotic treatments.

MATERIALS AND METHODS

1. Selection of Homeopathic Medicines

For this study, two homeopathic remedies were selected: *Psoralea corylifolia* and *Ailanthus grandulosa*. The selection was based on their historical use in traditional and homeopathic medicine for treating bacterial infections. Both remedies were obtained as mother tinctures (undiluted plant extracts), which were sourced from GMP-certified homeopathic manufacturers to ensure consistency and quality. The remedies were then diluted into various homeopathic potencies, including 6C, 30C, 200C, 1M, and 10M, according to the guidelines set by the Homoeopathic Pharmacopoeia of India.

The mother tinctures and the diluted potencies were prepared using the process of potentization, which involves serial dilution and succussion (vigorous shaking) of the original substance. This process is believed to enhance the therapeutic potency of the remedy while minimizing its toxicity.

2. Bacterial Strains and Culture

Streptococcus mutans was selected as the test organism for this study. *S. mutans* is a facultative anaerobe and is a well-known contributor to dental caries, biofilm formation, and acid production in the oral cavity. The strain was cultured in a nutrient-rich medium to ensure optimal growth. Blood agar plates were used for culturing the bacteria, as this medium supports the growth of *S. mutans* and allows for the clear identification of bacterial colonies.

The bacteria were incubated at 37°C for 24 hours, a temperature that mimics human body conditions and ensures rapid bacterial growth. Once the bacterial culture was established, the experiment proceeded to test the antibacterial effects of the homeopathic remedies.

3. Agar Well Diffusion Method

The agar well diffusion method was employed to assess the antibacterial activity of the homeopathic remedies. This method is commonly used to evaluate the efficacy of antimicrobial agents in inhibiting bacterial growth in vitro. The steps involved in the agar well diffusion method are as follows:

- Sterilized Petri dishes containing solidified nutrient agar were inoculated with the *S. mutans* bacterial strain using a sterile swab.
- Wells (6mm in diameter) were cut into the agar using a sterile cork borer.
- Different potencies of the homeopathic remedies (*Psoralea corylifolia* and *Ailanthus grandulosa*) were introduced into the wells.
- A positive control (ofloxacin, a standard antibiotic) and a negative control (saline solution) were also introduced into separate wells to validate the results.
- The plates were incubated at 37°C for 24 hours.

After incubation, the plates were examined for zones of inhibition (ZOI), which are clear areas surrounding the wells where bacterial growth has been inhibited. The size of the ZOI was measured in millimeters using a digital caliper. The diameter of the ZOI reflects the antibacterial activity of the tested substance, with larger zones indicating greater efficacy.

4. Measurement and Statistical Analysis

The measurements of the zones of inhibition were recorded and compared between the different homeopathic potencies, the mother tinctures, and the controls. The results were analyzed statistically to determine the significance of the antibacterial activity observed in each preparation. An analysis of variance (ANOVA) test was conducted to assess the differences in the mean ZOI between the various groups, and post-hoc tests (Tukey's test) were performed to identify specific pairwise differences.

RESULTS

The in-vitro tests revealed important insights into the efficacy of *Psoralea corylifolia* and *Ailanthus grandulosa* against *Streptococcus mutans*. Both remedies demonstrated antibacterial activity, although the degree of inhibition varied depending on the preparation and potency used.

1. *Psoralea corylifolia* Results

The mother tincture of *Psoralea corylifolia* exhibited the highest antibacterial activity, producing a large zone of inhibition (ZOI) comparable to that of the positive control (ofloxacin). The size of the ZOI indicated that the mother tincture was effective in inhibiting the growth of *S. mutans*. Among the potencies tested, the 200C and 1M dilutions showed moderate antibacterial activity, with ZOIs smaller than those of the mother tincture but still significant. The 6C and 30C potencies produced smaller ZOIs, indicating weaker antibacterial effects at these lower dilutions.

2. *Ailanthus grandulosa* Results

Similar to *Psoralea corylifolia*, *Ailanthus grandulosa* exhibited antibacterial activity, but the zones of inhibition were generally smaller. The mother tincture of *Ailanthus grandulosa* produced a moderate ZOI, while the higher potencies (1M and 10M) demonstrated minimal antibacterial activity. The 6C and 30C potencies produced negligible ZOIs, suggesting that *Ailanthus grandulosa* may be less effective in its diluted form against *S. mutans* compared to *Psoralea corylifolia*.

3. Comparison with Standard Antibiotics

The positive control (ofloxacin) consistently produced the largest ZOI, confirming its efficacy as an antibiotic. The results of the homeopathic remedies, particularly the mother tinctures, showed significant antibacterial activity, but they did not surpass the effectiveness of the conventional antibiotic. Nonetheless, the results suggest that plant-based homeopathic medicines could play a complementary role in the treatment of streptococcal infections, particularly in the context of antibiotic resistance.

DISCUSSION

The results of this in-vitro study indicate that plant-origin homeopathic medicines, specifically *Psoralea corylifolia* and *Ailanthus grandulosa*, have the potential to inhibit the growth of *Streptococcus mutans*. The antibacterial activity observed in the mother tinctures suggests that these undiluted forms are particularly effective, while the higher potencies showed a reduced, but still present, antibacterial effect.

The significant inhibition of bacterial growth by the mother tinctures raises important questions about the mechanisms through which these homeopathic remedies exert their effects. One hypothesis is that the bioactive compounds present in the plant extracts are responsible

for the observed antibacterial activity. These compounds may include flavonoids, alkaloids, and other phytochemicals known for their antimicrobial properties. However, the process of dilution and succussion in homeopathy raises questions about the presence and concentration of these bioactive compounds in the higher potencies.

In classical homeopathy, higher dilutions are believed to work by stimulating the body's vital force rather than directly attacking pathogens. The observed differences in efficacy between the mother tinctures and the higher potencies suggest that lower dilutions or undiluted forms may be more suitable for treating bacterial infections. Further research is needed to explore the chemical composition of these remedies and to understand how the potentization process affects their antibacterial properties.

Mechanisms Of Action

One of the central questions raised by this study is the mechanism by which homeopathic remedies exert their antibacterial effects. While the exact mechanisms are not fully understood, several hypotheses have been proposed based on the bioactive components of the plant extracts and the principles of homeopathy.

1. **Direct Antimicrobial Action of Phytochemicals**

The mother tinctures of *Psoralea corylifolia* and *Ailanthus grandulosa* contain a range of bioactive compounds, including flavonoids, alkaloids, and terpenoids, which have been shown to possess antimicrobial properties. These compounds may directly inhibit bacterial growth by disrupting the bacterial cell membrane, interfering with protein synthesis, or inhibiting enzyme activity. The higher potencies, however, are diluted to such an extent that these compounds may no longer be present in measurable concentrations, which could explain the reduced efficacy of the higher dilutions.

2. **Stimulation of the Immune System**

According to the principles of homeopathy, highly diluted remedies may work by stimulating the body's immune system rather than exerting a direct antimicrobial effect. This stimulation could enhance the body's ability to fight off infections by boosting the activity of immune cells, such as macrophages and lymphocytes. While this mechanism is difficult to demonstrate in an in-vitro setting, it could explain the clinical efficacy of higher potencies in treating infections, even when the direct antibacterial activity is reduced.

3. **Effect on Bacterial Biofilms**

Streptococcus mutans is known for its ability to form biofilms, which are protective layers of bacteria that adhere to surfaces, such as teeth, and resist antimicrobial agents. Some studies have suggested that homeopathic remedies may disrupt biofilm formation, making bacteria more susceptible to treatment. The mother tinctures of *Psoralea corylifolia* and *Ailanthus grandulosa* could potentially inhibit biofilm formation, thereby preventing the establishment of bacterial colonies and reducing the overall bacterial load.

HOMEOPATHY AND ANTIBIOTIC RESISTANCE

The rise of antibiotic resistance is one of the most pressing challenges in modern medicine. Bacterial resistance to antibiotics occurs when bacteria evolve mechanisms to evade the effects of antibiotics, rendering many treatments ineffective. This phenomenon has been exacerbated by the overuse and misuse of antibiotics, particularly in cases of viral infections, where antibiotics are ineffective.

Homeopathic remedies offer a potential solution to this problem. Because they do not rely on direct bactericidal action in the same way as antibiotics, they are less likely to contribute to the development of resistant bacterial strains. Additionally, homeopathic medicines, particularly those derived from plants, have been shown to enhance the body's natural immune response, helping to fight off infections without the need for antibiotics.

This study suggests that homeopathic remedies such as *Psoralea corylifolia* and *Ailanthus grandulosa* could play a role in reducing the reliance on antibiotics, particularly in cases of mild to moderate infections. By offering an alternative treatment option, homeopathy could help slow the spread of antibiotic resistance and preserve the efficacy of existing antibiotics for more severe infections.

LIMITATIONS OF THE STUDY

While this in-vitro study provides valuable insights into the antibacterial properties of plant-origin homeopathic medicines, there are several limitations to consider:

1. **In-Vitro Nature of the Study**

In-vitro studies, while useful for evaluating the direct effects of antimicrobial agents, do not fully replicate the complexity of the human body. The immune system, tissue interactions, and other factors that play a role in infection management are not represented in an in-vitro environment. Further in-vivo studies and clinical trials are needed to confirm the efficacy of these homeopathic remedies in treating streptococcal infections in real-world settings.

2. **Variability in Potency Efficacy**

The study observed variability in the efficacy of different potencies, with the mother tinctures showing the greatest antibacterial activity. This raises questions about the optimal dilution for treating bacterial infections. Further research is needed to explore the relationship between potency and therapeutic efficacy, particularly in clinical applications.

3. **Lack of Mechanistic Understanding**

While the study demonstrated the antibacterial activity of the homeopathic remedies, the exact mechanisms of action remain unclear. Further research is needed to explore the chemical composition of the remedies, particularly in higher potencies, and to understand how they exert their effects on bacteria.

CONCLUSION

This in-vitro study demonstrates that homeopathic medicines derived from plants, specifically *Psoralea corylifolia* and *Ailanthus grandulosa*, possess antibacterial activity against *Streptococcus mutans*. While the mother tinctures showed the most significant inhibition of bacterial growth, the higher potencies exhibited reduced antibacterial effects. These findings suggest that plant-based homeopathic remedies could serve as complementary therapies in the treatment of streptococcal infections, particularly in cases where antibiotic resistance is a concern.

Further research is needed to explore the clinical applications of these remedies, including in-vivo studies and trials to determine the optimal dosage and administration methods. Additionally, investigating the mechanisms behind the antibacterial activity of these homeopathic medicines will provide a deeper understanding of their therapeutic potential.

By offering an alternative to conventional antibiotics, homeopathic medicines may play a role in addressing the growing problem of antibiotic resistance, helping to preserve the efficacy of antibiotics for future generations.

REFERENCES

1. Global burden of bacterial antimicrobial resistance 1990-2021: a systematic analysis with forecasts to 2050 Naghavi, Mohsen et al. The Lancet. 404:1199–226.
2. Newberger R, Gupta V. Streptococcus group A. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024.
3. Zhou G, Shi Q-S, Huang X-M, Xie X-B. The three bacterial lines of defense against antimicrobial agents. Int J Mol Sci [Internet]. 2015;16(9):21711–33. Available from: http://dx.doi.org/10.3390/ijms160921711
4. Sankha S, Tasneem H. Male sexual dysfunction: Hahnemann's obvious cause of the modern generation. Int J Homoeopathic Sci [Internet]. 2023;7(4):35–7. Available from: http://dx.doi.org/10.33545/26164485.2023.v7.i4a.956
5. Kanwal S, Vaitla P. Streptococcus pyogenes. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024.
6. Ahmed SK, Hussein S, Qurbani K, Ibrahim RH, Fareeq A, Mahmood KA, et al. Antimicrobial resistance: Impacts, challenges, and future prospects. Journal of Medicine, Surgery, and Public Health [Internet]. 2024;2(100081):100081. Available from: http://dx.doi.org/10.1016/j.glmedi.2024.100081
7. WHO updates list of drug-resistant bacteria most threatening to human health [Internet]. Who.int. [cited 2024 Oct 28]. Available from: https://www.who.int/news/item/17-05-2024-who-updates-list-of-drug-resistant-bacteria-most-threatening-to-human-health
8. The Editors of Encyclopedia Britannica. homeopathy. In: Encyclopedia Britannica. 2024.
9. Garcia S. Pandemics and traditional plant-based remedies. A historical-botanical review in the era of COVID19. Front Plant Sci [Internet]. 2020;11. Available from: http://dx.doi.org/10.3389/fpls.2020.571042
10. Khushboo PS, Jadhav VM, Kadam VJ, Sathe NS. Psoralea corylifolia Linn.-"kushtanashini". Pharmacogn Rev [Internet]. 2010;4(7):69. Available from: http://dx.doi.org/10.4103/0973-7847.65331
11. Pastorino P, Prearo M, Barceló D. Ethical principles and scientific advancements: In vitro, in silico, and non-vertebrate animal approaches for a green ecotoxicology. Green Analytical Chemistry [Internet]. 2024;8(100096):100096. Available from: http://dx.doi.org/10.1016/j.greeac.2024.100096
12. Hahnemann S. Organon of medicine. New Delhi, India: B Jain; 2023.
13. Allen HC. Allens' keynotes: Rearranged & classified. New Delhi, India: B Jain; 2022.
14. Boericke W. Pocket manual of homeopathic materia medica & repertory. New Delhi, India: B Jain; 2023.