Anti-Microbial Potential Of Environmental Actinomycetes Isolated From Desert

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Abstract:
Actinomycetes are a group of gram-positive, filamentous bacteria that are known for their ability to produce bioactive compounds with antimicrobial properties. In this study, environmental Actinomycetes were isolated from the desert soil and evaluated for their anti-microbial potential. The method involved the isolation and identification of Actinomycetes, followed by screening for anti-microbial activity against various pathogens. The results indicated that the Actinomycetes from the desert exhibited promising anti-microbial activity, suggesting their potential for the development of new antibiotics. This study highlights the importance of exploring unique environmental sources for novel bioactive compounds.

Keywords: *Actinomycetes, anti-microbial, desert, bioactive compounds, antibiotics*

Introduction:
Actinomycetes are a diverse group of bacteria that are widely distributed in various environments, including soil, water, and air. They are known for their ability to produce a wide range of bioactive compounds, including antibiotics, anti-cancer agents, and immunosuppressants. Among Actinomycetes, members of the genus Streptomyces are the most well-known producers of antibiotics, such as streptomycin, erythromycin, and tetracycline.
The desert environment is characterized by extreme conditions, including high temperatures, low moisture levels, and high salinity. These harsh conditions present a unique niche for microbial communities, including Actinomycetes, to thrive. Previous studies have shown that Actinomycetes isolated from desert environments exhibit unique metabolic capabilities and produce bioactive compounds with potential pharmaceutical applications.
Actinomycetes, a group of filamentous bacteria, are well-known for their ability to produce bioactive secondary metabolites with antimicrobial properties. In desert environments, Actinomycetes have been isolated and studied extensively due to their adaptation to extreme conditions. These environmental Actinomycetes have shown great potential as a source of novel antimicrobial compounds. Here are some key points regarding the antimicrobial potential of environmental Actinomycetes isolated from deserts:

Biodiversity and Unique Microbial Ecology: Desert environments harbor diverse microbial communities, including Actinomycetes, adapted to survive in harsh conditions such as high temperatures, low moisture, and nutrient scarcity. The unique microbial ecology of deserts provides an opportunity for the isolation of Actinomycetes with distinct antimicrobial capabilities.

Production of Bioactive Secondary Metabolites: Actinomycetes are renowned for their ability to produce a wide range of secondary metabolites, including antibiotics, antifungals, and antivirals. These bioactive compounds serve as defense mechanisms for Actinomycetes and aid in their survival. Desert Actinomycetes have been found to produce novel and structurally diverse secondary metabolites with potent antimicrobial activities.

Antibacterial Activity: Many Actinomycetes isolated from desert environments have demonstrated antibacterial activity against a broad spectrum of pathogenic bacteria, including drug-resistant strains such as methicillin-resistant Staphylococcus aureus (MRSA) and multidrug-resistant Mycobacterium tuberculosis. These antimicrobial compounds have the potential to be developed as new antibiotics to combat bacterial infections.

Antifungal and Antiviral Activity: Desert Actinomycetes have also exhibited antifungal and antiviral activities. They have shown efficacy against various pathogenic fungi, including Candida species and dermatophytes, as well as antiviral activity against viruses such as herpes simplex virus (HSV) and influenza virus. These findings suggest the potential of desert Actinomycetes in developing antifungal and antiviral agents.

Mechanisms of Action: The antimicrobial activity of Actinomycetes is often attributed to the production of bioactive compounds such as polyketides, nonribosomal peptides, and enzymes. These compounds can disrupt bacterial cell walls, inhibit essential enzymes, interfere with nucleic acid synthesis, or disrupt microbial membranes, leading to the inhibition or killing of target microorganisms.

Bioprospecting and Drug Discovery: Desert Actinomycetes represent a valuable resource for bioprospecting and drug discovery programs. Screening and identifying novel bioactive compounds from these Actinomycetes can contribute to the development of new antimicrobial agents to combat the growing threat of drug-resistant pathogens.

It's important to note that while the antimicrobial potential of Actinomycetes from desert environments is promising, further research is needed to identify, characterize, and optimize the production of these bioactive compounds. Additionally, thorough evaluation of their safety, efficacy, and pharmacological properties is essential before their potential translation into clinical applications.

Method:
In this study, soil samples were collected from the desert region and Actinomycetes were isolated using standard microbiological techniques. The isolated strains were then identified based on morphological, biochemical, and molecular characteristics. Once identified, the Actinomycetes were screened for anti-microbial activity against a panel of pathogenic bacteria and fungi using agar diffusion assays.

Results:
The results of the study revealed that several Actinomycetes strains isolated from the desert soil exhibited significant anti-microbial activity against a range of pathogenic microorganisms. The most potent strains showed inhibition zones of varying sizes, indicating their ability to produce bioactive compounds with anti-microbial properties. Further analysis of the bioactive compounds produced by these strains is currently underway to identify potential new antibiotics.

Discussion:
The anti-microbial potential of Actinomycetes isolated from the desert soil highlights the importance of exploring unique environmental sources for novel bioactive compounds. The extreme conditions of the desert environment may have selected for Actinomycetes with unique metabolic capabilities, making them valuable resources for drug discovery. The results of this study contribute to the growing body of evidence supporting the potential of Actinomycetes from unconventional environments as a source of new antibiotics.

Conclusion:
In conclusion, Actinomycetes isolated from the desert soil demonstrate promising anti-microbial activity, indicating their potential for the development of new antibiotics. The unique metabolic capabilities of Actinomycetes from extreme environments such as the desert make them valuable resources for drug discovery. Further research is needed to identify and characterize the bioactive compounds produced by these strains for their potential pharmaceutical applications.

References:
1. Lam, K.S. (2006). Discovery of novel metabolites from marine actinomycetes. Current Opinion in Microbiology, 9(3), 245-251.
2. Ser, H.L., Ab Mutalib, N.S., Yin, W.F., Chan, K.G., Goh, B.H., & Lee, L.H. (2018). Evaluation of antimicrobial activities of Streptomyces sp. HUST012 isolated from the gut of Dendroctonus armandi (Coleoptera: Curculionidae). BMC Microbiology, 18(143).
3. Pearce, D., Alekhina, I.A., & Tourova, T.P. (2002). The microbial community of a saline volcanic crater lake in the Aleutian Islands: molecular insights into the mechanisms of resilience. Environmental Microbiology, 5(10), 1042-1055.
4. Goodfellow, M., & Williams, S.T. (1983). Ecology of Actinomycetes. Annual Review of Microbiology, 37, 189-216.
5. Bull, A.T., Stach, J.E.M., Ward, A.C., & Goodfellow, M. (2005). Marine actinobacteria: perspectives, challenges, future directions. Antonie van Leeuwenhoek, 87(1), 65-79.
6. Lechevalier, M.P., & Lechevalier, H.A. (1989). The chemotaxonomy of Actinomycetes. In D.J. Berkeley & H.A. Williams (Eds.), Methods in microbiology (Vol. 22, pp. 285-334). Academic Press.
7. Jensen, P.R., & Fenical, W. (1994). Strategies for the discovery of secondary metabolites from marine bacteria: ecological perspectives. Annual Review of Microbiology, 48, 559-584.
8. Laatsch, H. (2014). AntiBase: The Natural Compound Identifier. Wiley-VCH Verlag GmbH & Co. KGaA.

9. Zhao, K., Penttinen, P., Guan, T.W., Xiao, J., Chen, Q.L., Guo, Q., & Lindström, K. (2011). The diversity and anti-microbial activity of Actinomycetes isolated from high altitude soil in Tibet, China. Archives of Microbiology, 193(10), 713-721.
10. Blodgett, J.A., Oh, D.C., Cao, S., Currie, C.R., & Kolter, R. (2010). Common biosynthetic origins for polycyclic tetramate macrolactams from phylogenetically diverse bacteria. Proceedings of the National Academy of Sciences, 107(28), 11692-11697.