Volume 3, Issue 10, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

ANTIBACTERIAL, ANTI-INFLAMMATORY AND ANTIDIABETIC EFFECTS OF STREPTOMYCES GRISEUS: AN IN VITRO STUDY

Muhammad Hassan Shabbir[1], Ruqayyah Moiz[2], Qamar ul Zaman[3], Fania Rashid[4], Muhammad Faisal Iqbal[5], Mirza Muhammad Maroof Baig[5], Zeeshan Ali[5], Maria Mumtaz[6], Khadija Haider[7], Asma Irshad[8], Tehreem Fatima[5], Anas Jahangir[9], Muhammad Ahmad Afzal[*10]

[1]*National Institute of Food Science and Technology, University of Agriculture Faisalabad, Faisalabad, Pakistan*
[2]*Faculty of Life Science, Institute of Microbiology, Government College University Faisalabad, Faisalabad, Pakistan*
[3]*Departemnt of Applied Chemistry, Government College University Faisalabad, Faisalabad, Pakistan*
[4]*Departemnt of Chemistry, Government College University Lahore, Lahore, Pakistan*
[5]*School of Biochemistry and Biotechnology, University of Punjab, Lahore, Pakistan*
[6]*Medical Laboratory Technology, University of Health Sciences Lahore, Pakistan*
[7]*Nutritional and Health Promotion, University of Home Economics Lahore, Pakistan*
[8]*Departemnt of Biochemistry, Government College University Faisalabad, Faisalabad, Pakistan*
[9]*Lecturer, Department of Operation Theater Technology, Faculty of Allied Health Sciences, Rashid Latif Khan University, Lahore, Pakistan*
[*10]*Department of Human Nutrition and Dietetics, Faculty of Medical Sciences, Government College University Faisalabad, Faisalabad, Pakistan*

[*10]ahmadansarians17@gmail.com

DOI: https://doi.org/10.5281/zenodo.18051578

Keywords
Streptomyces griseus, antidiabetic, anti-inflammatory, bioactive compounds, actinobacteria

Article History
Received: 27 October 2025
Accepted: 11 December 2025
Published: 25 December 2025

Copyright @Author

Corresponding Author: *
Muhammad Ahmad Afzal

Abstract

Streptomyces griseus is a beneficial and well-known actinobacterium that produces various types of bioactive metabolites. This work investigates the antibacterial, antidiabetic and anti-inflammatory potential of Streptomyces griseus to explore its therapeutic potential. The crude extract of this bacterium was evaluated for antibacterial potential against selected pathogenic bacteria. The anti-inflammatory potential was measured through protein denaturation assay. Further, the antidiabetic potential was observed using an amylase inhibitory assay. The findings demonstrated considerable antibacterial potential against tested bacterial strains and also showed notable anti-inflammatory potential by reducing protein denaturation. Moreover, this bacterium showed a promising antidiabetic effect through the inhibition of carbohydrate-hydrolyzing enzymes. Overall, these outcomes showed that Streptomyces griseus is a beneficial source of bioactive metabolites with multifunctional therapeutic applications. This bacterium could arise as an auspicious candidate for the production of novel natural bioactive compounds.

INTRODUCTION

Different types of pathogenic microbes, such as Escherichia coli, Salmonella sp and Aspergillus sp, pose a serious risk of contaminating the food (Viana et al., 2025). Food-borne diseases caused by pathogenic microbes are a global concern, prominent to harmful effects on public health and food material (Liu et al., 2023). E. coli, which is commonly found in the intestinal tract of animals and humans, is

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

greatly present in the environment (Jang et al., 2017). Ingestion of polluted food like vegetables and meat is the main transmission mode for these pathogens (Mohammad et al., 2018). Whereas some E. coli strains are not harmful and some are pathogenic in nature, even causing death (Hassan et al., 2021). Further, Salmonella sp. is also a foodborne pathogen and is responsible for various types of infections and also weakens the immunity (Galán, 2021; Pervaiz et al.). It is also majorly present in dairy products. This bacterium can contaminate the food and it can easily survive at any temperature (Mikołajczyk et al., 2024). This bacterium causes various types of diseases like fever, abdominal pain, and diarrhea. Moreover, Aspergillus sp (pathogenic fungus) is mainly present in the environment and is an opportunistic pathogen. It can also contaminate different types of food products (Kundu et al., 2024).

To combat these types of pathogens various types of physical and chemical methods are used to extend the shelf life of food products (Lohita & Srijaya, 2024). Though, most of these preservatives, like sodium benzoate and sodium sorbate, are banned in many countries (Yazdanfar et al., 2023). So, there is a great need to use alternative methods to combat these types of pathogens. One of the most important alternative approaches is to use beneficial microbes (Bakr et al., 2025). These types of microbes produced various types of bioactive metabolites like antimicrobial, anti-inflammatory and antidiabetic compounds (Yarahmadi et al., 2025).

Streptomyces are beneficial bacteria and produce various types of bioactive compounds such as antibiotics, organic acids, peptides, and cyclic dipeptides (Driche et al., 2025). These bacteria are widely used in the drug industry. Further, the Streptomyces griseus is a species of Streptomyces that produces different types of bioactive metabolites, like peptides, and also produces enzymes (Saied et al., 2025). This work investigates the antibacterial, anti-inflammatory and antidiabetic potential of Streptomyces griseus. This beneficial microbe could emerge as a potential agent.

Material and method

Bacterial culture

The bacterial culture (Streptomyces griseus) was obtained from the Culture Bank, University of Punjab, Lahore, Pakistan. This culture was maintained in LB broth medium and stored at 4°C.

Extraction of compounds from Streptomyces griseus

The Streptomyces griseus culture was grown in LB broth medium for 5 days at 37°C and after that culture was centrifuged to obtain supernatant, and compounds were extracted by using ethyl acetate as the extracting solvent.

Antibacterial activity

The antibacterial potential of extracted metabolites of Streptomyces griseus was determined against E. coli, S. aureus, Salmonella sp, Bacillus cereus and Serratia marcescens. These bacteria were spread on LB agar plate by using a cotton swab and 8 mm holes were formed in agar plate. The antibacterial potential was measured by using the agar well diffusion method. 100 µL of Streptomyces griseus extract was loaded in well and plates were incubated for 16 h at 35°C. After that, the zone of inhibition was noted by ruler (Danjuma & Lawan, 2025).

Anti-inflammatory activity

Anti-inflammatory potential of extracted metabolites was measured by protein denaturation assay. Extracted compounds (10, 20, 40, 80, 160 µL/mL) concentration were added in 1mL of bovine serum albumin, and the mixture was boiled at 80°C for 20 min. This experiment was conducted in triplicate and optical density was measured at 660 nm (Srinivasan et al., 2025).

Antidiabetic potential

100 µL of extracted metabolites were mixed in 200 µL of alpha amylase solution and the reaction was incubated for 20 min at 35 °C. After that, 100 µL of starch solution was added, and the mixture was again incubated for 35 min at 37 °C. Then the 100 µL of dinitro-salicylic acid solution was added in each tube and the tubes were heated for 10 min at 50 °C. Then absorbance was noted at 540 nm (Lankatillake et al., 2021).

Analysis

All the test was performed in triplicate and the data was analyzed in Microsoft excel.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Results

Antibacterial potential

Metabolites of Streptomyces griseus showed potential antibacterial activity against pathogenic bacterial strains (E. coli, S. aureus, Salmonella sp, Bacillus cereus and Serratia marcescens) and the observed zone of inhibitions were 23±0.43, 26±0.76, 17±0.34 and 33±0.65, respectively.

Anti-inflammatory activity by bovine serum albumin

The protein denaturation was observed in this work and it was observed that the anti-inflammatory activity of extracted metabolites was improved in dose dose-dependent manner. The maximum inhibition was noted at highest (600 µg/mL) (Figure 1).

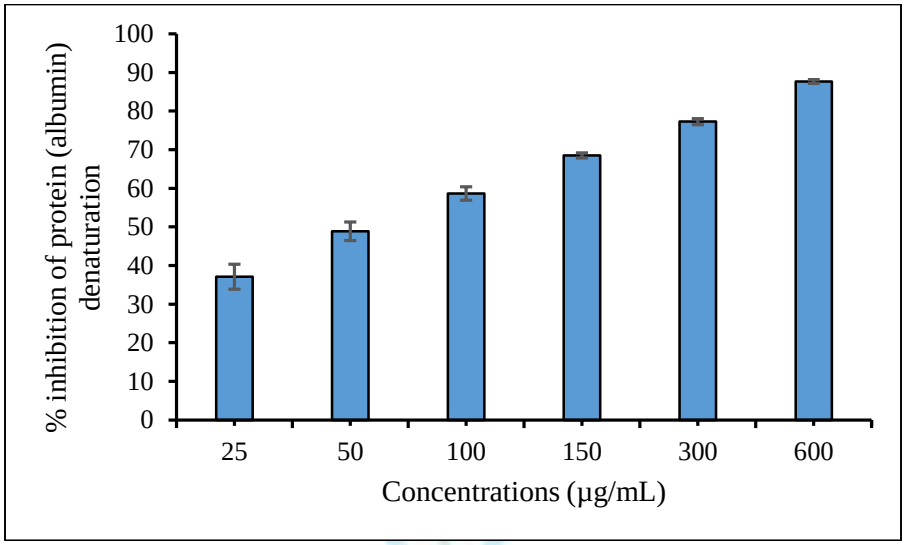


Figure 1: % of Protein (albumin) denaturation in concentration concentration-dependent manner.

Antidiabetic activity

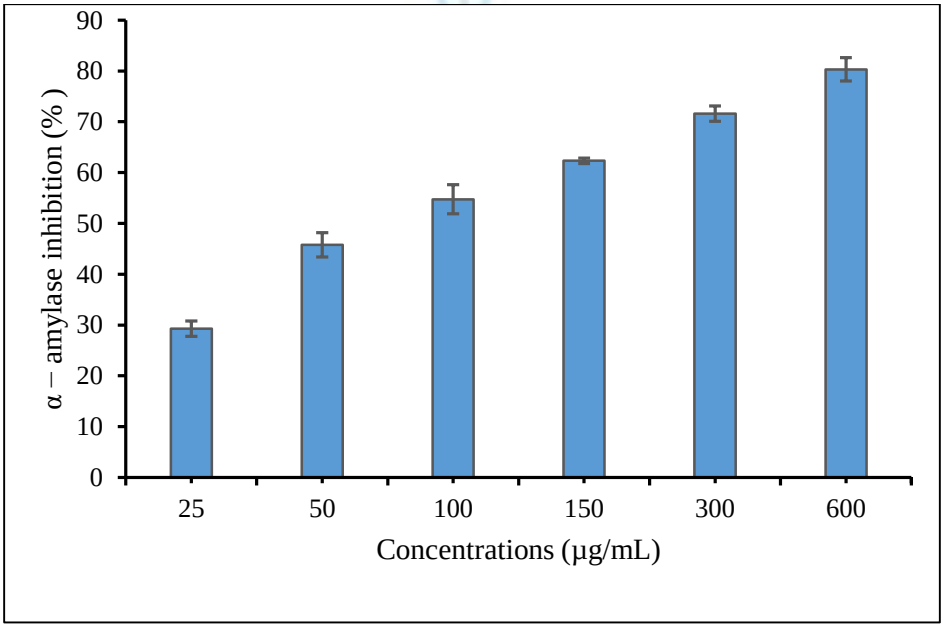


Figure 2: % of pancreatic α-amylase inhibition in concentration concentration-dependent manner

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Antidiabetic activity

The current work described that extracted compounds inhibit pancreatic alpha-amylase (enzyme) activity. The inhibition of amylase was observed at different concentrations and maximum inhibition was noted at higher concentration (600 µg/mL) (Figure 2).

Discussion

Streptomyces bacteria play an important role in the medical field (Al-Quwaie, 2024; Tariq et al., 2025). The production of bioactive compounds is steadily increasing because of the growing threat of pathogenic bacterial strains. Inhibition of pathogenic microbes by the production of bioactive metabolites is a highly effective biocontrol method against pathogenic microorganisms (Ali Mude et al., 2025). Therefore, the current work was focused on the extraction of bioactive compounds by Streptomyces griseus. In this work, the Streptomyces griseus metabolites showed potent antibacterial activity against pathogenic bacterial strains. (Al-Ansari et al., 2019).

Furthermore, our results also demonstrated that the extracted metabolites showed potential anti-inflammatory activity and previously it was reported that the Streptomyces sp showed anti-inflammatory potential (Gomathi & Gothandam, 2019). Our study also proved that metabolites of Streptomyces griseus had anti-diabetic activity and inhibited pancreatic α-amylase enzyme (primary enzyme responsible for converting dietary starch into glucose) in dose dose-dependent manner. Previously, it was reported that some species of actinobacteria had potent antidiabetic potential (Hrdý et al., 2020).

Overall, the antibacterial, antidiabetic and anti-inflammatory activities of Streptomyces griseus metabolites emphasize its therapeutic potential. This bacterium could arise as an auspicious candidate for the production of novel natural bioactive compounds. Though, additional work is required to isolate and characterize the active compounds, elucidate their mechanisms of action, and evaluate their safety and efficacy through in vivo and clinical investigations.

Conclusion

The present work demonstrated that Streptomyces griseus showed a notable antibacterial, antidiabetic and anti-inflammatory potential. The noted antibacterial potential suggests its possible benefits in inhibiting the pathogenic microbes, while the anti-inflammatory potential of this bacterium demonstrates its role in glucose metabolism regulation. These outcomes suggested the therapeutic potential of this bacterium. Furthermore, this bacterium also shown the potential antidiabetic activity. This work is further enhanced to isolate and identify bioactive metabolites and to confirm their efficacy and safety through clinical trials. Consequently, this bacterium could emerge as a potential candidate for the production of novel and beneficial drugs.

REFERENCES

Al-Ansari, M., et al. (2019). Antimicrobial potential of Streptomyces sp. to the Gram positive and Gram negative pathogens. Journal of infection and public health, 12(6): 861-866.

Al-Quwaie, D. A. (2024). The role of Streptomyces species in controlling plant diseases: a comprehensive review. Australasian Plant Pathology, 53(1): 1-14.

Ali Mude, A. S., et al. (2025). Therapeutic application of Streptomyces: A choice alternative to modern therapies. Microbes and Infectious Diseases, 6(2): 916-928.

Bakr, R., et al. (2025). The Potential of Beneficial Microbes for Sustainable Alternative Approaches to Control Phytopathogenic Diseases. Microbiology Research, 16(5): 105.

Danjuma, K., & Lawan, I. (2025). Evaluation of Antioxidant and Antibacterial Activities of Telfairia occidentalis Leaves Sold in Idah, Kogi State, Nigeria. Arabian Journal of Chemical and Environmental Research, 12(2): 138-151.

Driche, E.-H., et al. (2025). Antibacterial and antibiofilm properties of two cyclic dipeptides produced by a new desert Streptomyces sp. HG-17 strain against multidrug-resistant pathogenic bacteria. International Microbiology, 28(2): 241-255.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Galán, J. E. (2021). Salmonella Typhimurium and inflammation: a pathogen-centric affair. Nature Reviews Microbiology, 19(11): 716-725.

Gomathi, A., & Gothandam, K. M. (2019). Investigation of anti-inflammatory and toxicity effects of mangrove-derived Streptomyces rochei strain VITGAP173. Journal of cellular biochemistry, 120(10): 17080-17097.

Hassan, A., et al. (2021). Escherichia coli as a global pathogen. Funksec here, 3(1): 239-260.

Hrdý, J., et al. (2020). Inhibition of Pro-Inflammatory Cytokines by Metabolites of Streptomycetes—A Potential Alternative to Current Anti-Inflammatory Drugs? Microorganisms, 8(5): 621.

Jang, J., et al. (2017). Environmental Escherichia coli: ecology and public health implications—a review. Journal of applied microbiology, 123(3): 570-581.

Kundu, R., et al. (2024). The Zoonotic Potential of Fungal Pathogens: Another Dimension of the One Health Approach. Diagnostics, 14(18): 2050.

Lankatillake, C., et al. (2021). Screening natural product extracts for potential enzyme inhibitors: protocols, and the standardisation of the usage of blanks in α-amylase, α-glucosidase and lipase assays. Plant Methods, 17(1): 3.

Liu, X., et al. (2023). Biofilm formation and control of foodborne pathogenic bacteria. Molecules, 28(6): 2432.

Lohita, B., & Srijaya, M. (2024). Novel technologies for shelf-life extension of food products as a competitive advantage: A review. Food production, diversity, and safety under climate change: 285-306.

Mikołajczyk, M., et al. (2024). Impact on Human Health of Salmonella Spp. and Their Lipopolysaccharides: Possible Therapeutic Role and Asymptomatic Presence Consequences. International Journal of Molecular Sciences, 25(22): 11868.

Mohammad, A.-M., et al. (2018). Food poisoning and intoxication: A global leading concern for human health Food safety and preservation (pp. 307-352): Elsevier.

Pervaiz, A., et al. Exploring Actinomycetes as Antiviral Potential against New Castle Disease: A Promising Avenue.

Saied, A., et al. (2025). Optimization and bioactive compounds production by Streptomyces griseus to resist Staphylococcus aureus isolated from human semen. Biological and Biomedical Journal, 3(2): 264-275.

Srinivasan, M. K., et al. (2025). Phytochemical composition, biological activities, and molecular docking studies of ethanolic fruit extract of Tribulus terrestris: an in vitro and in silico approach. 3 Biotech, 15(12): 444.

Tariq, N., et al. (2025). Prospects of Actinomycetes as potential candidates with diverse biological functionalities: a special focus on Streptomyces hygroscopicus to treat poultry disease. World's Poultry Science Journal: 1-20.

Viana, G. G. F., et al. (2025). Antimicrobial Resistant Staphylococcus spp., Escherichia coli, and Salmonella spp. in Food Handlers: A Global Review of Persistence, Transmission, and Mitigation Challenges. Pathogens, 14(5): 496.

Yarahmadi, A., et al. (2025). Beyond antibiotics: exploring multifaceted approaches to combat bacterial resistance in the modern era: a comprehensive review. Frontiers in Cellular and Infection Microbiology, 15: 1493915.

Yazdanfar, N., et al. (2023). Evaluation of sodium benzoate and potassium sorbate preservative concentrations in different sauce samples in Urmia, Iran. Journal of Food Protection, 86(8): 100118.