CHRIST
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# Notice for the PhD Viva-Voce Examination

Ms Soma Biswas (Registration Number: 1981606), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Tuesday, 26 November 2024 at 11.00 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

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| **Title of the Thesis** | : | **Isolation, Screening and Characterisation of Endophytes from Madiwala Lake for Biosurfactant, Bioremediation and Plant-Growth Promotion Properties** |
| **Discipline** | : | **Biotechnology** |
| **External Examiner**<br>(Outside Karnataka) | : | **Dr Sabu Thomas**<br>Professor and Director<br>Centre of Excellence in Microbiome<br>KSCSTE, Government of Kerala<br>Thiruvananthapuram<br>Kerala |
| **External Examiner**<br>(Within Karnataka) | : | **Dr M S Dinesh**<br>Associate Professor<br>Department of Biotechnology<br>P E S University, 100 Feet Ring Road<br>BSK III Stage, Bengaluru – 560085<br>Karnataka |
| **Supervisor** | : | **Dr Suma S**<br>Associate Professor<br>Department of Life Sciences<br>School of Sciences<br>CHRIST (Deemed to be University)<br>Bengaluru- 560029<br>Karnataka |

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

**Registrar**

**Place:** Bengaluru
**Date:** 20 November 2024

# ABSTRACT

The significant surge in population, combined with the degradation of the environment, has imposed substantial stress on worldwide food security. The concerning pace of population growth, along with escalating environmental harm due to heightened industrialization, has indeed exerted considerable pressure on the global food provision. Considering the existing situation, the sustainable approach to enhance agricultural yield and facilitate environmental bioremediation entails utilizing endophytes that reside within plants. Endophytic microorganisms possessing the capacity to promote plant growth and exert biocontrol can significantly boost plant development amidst fluctuating environmental factors, both biotic and abiotic in nature. The current research aimed to extract bacterial and fungal endophytes from *Alternanthera philoxeroides* and *Alternanthera paranichoides* and evaluate their potential for enhancing plant growth and controlling pests. Among the isolated endophytic bacteria, *Klebsiella pneumoniae* exhibited various characteristics conducive to plant growth, leading to enhanced germination and vegetative growth in *Vigna unguiculata* plants. The isolate exhibited good Indoleacetic acid (IAA) production (48.75±2.95 µg/mL) and potassium solubilization (2.13±0.07 ppm). The IAA production by *K. pneumoniae* was further enhanced by 4-fold using the RSM optimization to 195.66±2.51 µg/mL. The endophytic bacteria *Bacillus amyloliquefaciens* and *Bacillus subtilis* showed good extracellular enzyme production and antimicrobial activity along with plant growth promotion.

The endophytic bacterium *B. amyloliquefaciens* showed good biosurfactant production and bioremediation efficiency. The strain displayed notable resistance to Cr and Pb concentrations upto 2000 mg/L. It was found to possess maximum metal removal efficiency for Pb, 92.3% at pH 9 and 86.2 at 25 °C. The isolated strain also demonstrated a 90% reduction in Cr (VI) within 48 h, starting from an initial concentration of 100 mg/L, which further increased to 99% within 96 h. The treatment with Cr (VI) resulted in the deposition of Cr (III) compounds onto the bacterial cell surface, as evidenced by SEM-EDX analysis of the bacterial precipitates. The FTIR analysis revealed the surface functional groups of *B. amyloliquefaciens* biomass, which are involved in biosorption of heavy metals. The biosurfactant produced by the isolate *B. amyloliquefaciens* showed good emulsification ability ($E_{24}$-52%) and stability of the biosurfactant was tested across various temperature (20-40 °C), pH (8-12), and salinity levels (5-15%). Through the optimization using RSM, the production of biosurfactant markedly enhanced the emulsification index ($E_{24}$) by 1.18 times, reaching 64%. Characterization of the biosurfactant through FTIR and UPLC-MS revealed lipopeptides like fengycin, iturin, and surfactin.

The diesel biodegradation by *B. amyloliquefaciens* was further analyzed and found to be 56.46±0.95%. GCMS analysis of diesel biodegradation by the isolate indicated the presence of diverse short-chain alkanes in the treated sample compared to the control, which is attributed to the microbial biodegradation of the hydrocarbon. The isolated fungal endophytes *Fusarium solani, Fusarium annulatum* and *Moesziomyces hubeiensis* demonstrated various positive traits conducive to plant growth promotion as well. The highest indole-3-acetic acid (IAA) production was observed in *F. solani*, reaching a concentration of 46.63±1.04 µg/mL, while ammonia production (7.88±0.14 µg/mL) and phosphate solubilisation (30.50±0.31 ppm) was highest for *M. hubeiensis*. The isolate *M. hubeiensis* exhibited excellent extracellular enzyme activity and biosurfactant production. The biosurfactant synthesized by *M. hubeiensis* exhibited stability across a spectrum of pH (3-5), temperature (30-50 °C), and salinity (10-50%). The biosurfactant was characterized as mannosylerythritol lipids (MEL) using FTIR and UPLC-MS. The optimization using RSM has resulted in almost 3-fold increase in emulsification index $E_{24}$ ($E_{24}$=63%).



*Keywords: Endophytes, Alternanthera philoxeroides, plant-growth promotion, IAA production, K. pneumoniae, B. amyloliquefaciens, M. hubeiensis, biosurfactant, heavy metal, diesel biodegradation, bioremediation.*


**Publications:**


1. **Biswas S**, Philip I, Jayaram S, Sarojini S. Endophytic Bacteria *Klebsiella spp.* and *Bacillus spp.* from *Alternanthera philoxeroides* in Madiwala Lake Exhibit Additive Plant Growth-promoting and Biocontrol Activities. Journal of Genetic Engineering and Biotechnology 21, 153 (2023). https://doi.org/10.1186/s43141-023-00620-8.
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13. Jaison JP, **Biswas S**, Philip I, Sebastian JK, Sarojini S. "Aluminum Stress: Toxicity and Tolerance in Plants". In Stress in Plants: The Hidden Half, edited by RK Upadhyay, 2023 (pp. 116-136). Newcastle upon Tyne: Cambridge. Scholars Publishing, United Kingdom