

## Synopsis Seminar

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| Seminar Title | : Bioprocess Development of Bacterial Polyhydroxyalkanoates: Efficient Production and Cost-effective Extraction for Potential Applications   |
| Speaker       | : Pritam Bajirao Patil ( Rollno : 519bm1016)   |
| Supervisor    | : Prof. Angana Sarkar  |
| Venue         | : Seminar Room (BM) (Hybrid)   |
| Date and Time | : 22 Jan 2025 (08:30 AM)   |
| Abstract      | <p>: The widespread use of synthetic plastics has increased the environmental risks, emphasizing the need for eco-friendly alternatives for their replacement. Among various bioplastics, bacterial Polyhydroxyalkanoates (PHAs) have been identified as a viable replacement. In this study, 94 bacterial isolates were screened using a 3-tiered process for PHA production, and five tested positive. Among those, two strains namely, PhNs9 and PhNs10, were selected for their non-virulence. The 16S rRNA gene sequencing revealed that PhNs9 and PhNs10 were related to the <i>Bacillus</i> and <i>Pseudomonas</i> genera, respectively, and the former was selected for its superior yield. Different characterizations of the PHA produced by <i>Bacillus</i> sp. PhNs9 in glucose medium revealed it to be Polyhydroxybutyrate (PHB). Process optimization using response surface methodology (RSM) and the bioreactor scale production resulted in a PHA yield of 2.70 gL<sup>-1</sup> corresponding to 71% accumulation in biomass (YP/X). The PHB also demonstrated excellent biodegradability in different environments with 99% degradation in soil in 30 days. Sugarcane molasses (SM) was selected as a cost-effective substrate due to its higher yield among screened industrial byproducts and wastes. A fed-batch process was developed and optimized using an artificial neural network (ANN) and genetic algorithm (GA) which increased the PHA yield to 3.72 gL<sup>-1</sup> and YP/X of 0.79 gg<sup>-1</sup> at the bioreactor scale. The produced PHA was similar to Polyhydroxybutyrate-valerate (PHBV). Techno-economic analysis of the developed process resulted in a minimum selling price of PHA as \$12 kg<sup>-1</sup> confirming its commercial viability. For PHA extraction, a novel process of electrochemical cell lysis (ECL) was developed, optimized using ANN-GA, and automatized using the principle of turbidometry. It was studied to reduce the downstreaming cost by 80.40% maintaining the characteristics of PHA. A biocomposite was prepared by blending extracted PHA, neem oil, and threadlets. It was found to be antibacterial, non-cytotoxic, and biodegradable with higher tensile strength. The different bioactive compounds like nimbin, azadirachtin, and salannin providing medicinal properties were confirmed for their presence in neem oil through high-resolution mass spectroscopy (HR-MS). The cost of prepared biomaterial was calculated to be ₹ 0.29 cm<sup>-2</sup>, highlighting the process's economic viability in commercializing PHAs as an eco-friendly alternative to synthetic plastics, especially in the field of medicine.</p> |

Keywords: Polyhydroxyalkanoates *Bacillus* Sugarcane molasses Fed-batch Electrochemical cell lysis Biocomposite.