National Institute of Technology Rourkela

Defence Seminar

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| Seminar Title | : Exploring marine Streptomyces for the development of biopolymer based biomaterials and biofilm mediated degradation of polycyclic aromatic hydrocarbon |
| Speaker | : Shivananda Behera ( Rollno : 519ls1011) |
| Supervisor | : Surajit Das |
| Venue | : Life Science Seminar Room |
| Date and Time | : 12 Sep 2025 (04:00 PM) |
| Abstract | : This thesis illustrates the metabolic potential of biofilm-forming marine *Streptomyces* for the biosynthesis of polyhydroxybutyrate (PHB) and extracellular polymeric substances (EPS), while also highlighting their capacity for phenanthrene degradation, showcasing their multifaceted role in sustainable bioremediation and biopolymer production. In this study, sediment samples were collected from four sites of the coastal region of Odisha, India. A total of 24 morphologically distinct *Streptomyces* spp. were isolated, of which 10 isolates showed biofilm-forming and PHB synthesizing potential. Among all the strains *Streptomyces nigra* KDS4 have shown strong biofilm-EPS formation with high PHB yielding (419.3 mg/g of dried biomass) potential. This bacterium has also shown highest growth and EPS biosynthesis (upto461.33±21.56 mg/L) in presence of different PAHs (naphthalene, phenanthrenen, and pyrene). Further the biofilm-EPS formation in this bacterium was investigated. Confocal laser scanning microscopy (CLSM) and COMSTAT analysis revealed peak biofilm formation at 60 hours of incubation, with subsequent dissociation by 84 hours. The amplification confirmed the presence of *cslA*, encoding cellulose synthase-like proteins involved in EPS and biofilm matrix development. The structural analysis of the EPS using FTIR, $^{1}$H NMR, and XRD indicated a heterogeneous biopolymer enriched with polysaccharides, proteins, lipids, and uronic acids. SEM and AFM imaging highlighted a robust fibrillar EPS network with nanoscale roughness aiding surface adhesion. Thermal stability was demonstrated by differential scanning calorimetry (DSC), with an endothermic peak near 130°C and significant decomposition above 300°C. The EPS exhibited strong antioxidant activity and notable emulsifying capacity, supporting its functional relevance. Furthermore, EPS-based hydrogels displayed excellent porosity and mechanical integrity, emphasizing their suitability for biomedical applicationsThe optimization of process parameters revealed that slightly alkaline pH, moderate salinity, and a C:N ratio of 20:1 (w/w) using starch and $KNO_3$ as carbon and nitrogen sources, respectively, significantly enhanced PHB production (2.63 g/L). The PHB synthesis was found to be growth-associated and scalable in bioreactor conditions. Additionally, cytocompatibility assays confirmed its non-toxic and biocompatible nature, suggesting its suitability for biomedical applications. These findings collectively demonstrate the remarkable adaptability of *Streptomyces nigra* KDS4 in modulating EPS and PHB production under phenanthrene stress, supporting its dual functionality in biopolymer synthesis and environmental detoxification. Its robust biofilm architecture, enhanced EPS secretion, and efficient phenanthrene degradation highlight its promise as a sustainable bioresource for integrated bioremediation and industrial applications. |