Photobacterium halotolerans: genomic analysis and fermentative production of Polyhydroxyalkanoates (PHAs)

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Environmental pollution caused by the accumulation of petrochemical-based plastics has driven the search for sustainable, biodegradable alternatives derived from renewable resources. Among these, polyhydroxyalkanoates (PHAs) are promising microbial biopolymers due to their biodegradability and physicochemical properties comparable to conventional plastics. However, their industrial-scale production remains limited by high costs and low yields compared to synthetic plastics. Halophilic and halotolerant microorganisms are valuable biotechnological resources, as high salinity may promote PHA accumulation. Here, the PHA production potential of the halotolerant bacterium *Photobacterium halotolerans*, isolated from the salt pans of Tarquinia (Viterbo, Italy), was investigated. To assess the biosynthetic potential of the strain, genomic analysis revealed the presence of the *phaBAPC* gene cluster. The genomic profile also indicated the ability to utilize various sugars, confirming a type I PHA biosynthetic pathway. Based on these findings, fermentation experiments were carried out in a bioreactor using different operational strategies, namely batch and fed-batch modes, to evaluate PHA production at different NaCl concentrations (0, 2.5, 5%), using glucose as the carbon source. Batch fermentation results showed a progressive increase in biopolymer accumulation with increasing salinity. Furthermore, a fed-batch strategy was developed as a process optimization approach, based on glucose feeding and pH control, involving the extension of the accumulation phase and nitrogen limitation. This strategy led to improved growth conditions and enhanced biopolymer production, achieving accumulation values above 60%. Overall, these results highlight the potential of *P. halotolerans* as a microbial platform for sustainable PHA production.