



Streptomyces coeruleorubidus strain SALG1 derived seashore plastic bottle for the biodegradation of untreated plastic polymers

Hanane Belabbas¹ · Ibtissem Djinni¹ · Warda Djoudi¹ · Wissam Reti¹ · Amel Hamma^{2,3} · Samiha Souagui¹ · Sara Haddad¹ · Mouloud Kecha¹

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Abstract

Plastic pollution has become a significant environmental concern due to the widespread use and persistence of polyethylene (PE) in various industries. In this study, soil samples containing plastic waste were collected from a public landfill site, along with plastic bottles gathered from the shore of Sidi Ali Lebher in the Bejaia region, Algeria. In total, nine strains of PE-degrading actinobacteria were isolated using PE as sole carbon source. The SALG1 strain was isolated from plastic bottles and selected for its high enzymatic potential and effectiveness in degrading PE. Selected from nine actinobacteria isolates, it was identified as *Streptomyces coeruleorubidus* with 98.28% similarity to *Streptomyces coeruleorubidus* type strain ISP 5145 T based on the 16S rRNA gene sequence analysis. The growth of SALG1 was evaluated using polyethylene glycol (PEG) as the sole carbon source, demonstrating a significant reduction in PEG concentration over a 14-day period, accompanied by biomass accumulation. Furthermore, SALG1 exhibited biosurfactant production and hydrophobicity, indicating its potential to interact with hydrophobic substrates like PE. Biodegradation experiments conducted over 2 and 6 months revealed SALG1's capability to degrade colorless and black PE (9.18% and 5.22%), as well as polystyrene (PS) and polyethylene terephthalate (PET) (0.25% and 0.42%) in both liquid and solid media. Moreover, the presence of Tween 80 enhanced degradation percentages, particularly in liquid media, suggesting its utility as a potential biostimulant. Structural changes induced by SALG1 activity in polymer films were characterized using X-ray diffraction (XRD) and infrared spectrophotometry (ATR), as well as the thermogravimetric analysis (TG/DTG) providing valuable insights into the degradation mechanism.

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Highlights

- Plastic pollution poses a significant environmental problem, affecting both land and sea ecosystems and endangering humans, animals, and their habitats.
- Biodegradation of polyethylene terephthalate, polyethylene, and polystyrene was studied using *Streptomyces coeruleorubidus* SALG1 strain.
- *Streptomyces coeruleorubidus* SALG1 was isolated from discarded bottles in a seashore in Algeria and selected based on black and colorless PE film degradation estimated at 4.54% and 3.29%, after 2 months of incubation.
- *Streptomyces coeruleorubidus* SALG1 strain has the ability to produce several enzymes, such as esterases and peroxidases. These enzymes are crucial in the degradation of polymers.
- The characterization of the films was carried out by measuring weight loss and conducting FTIR, TG/DTG and XRD analyses; the degradation of the polymer films was found to be significant, for colorless polyethylene reaching 9.18% after 6 months of incubation.

Extended author information available on the last page of the article