Title

Bacterial Polysaccharide-Stabilized Silver Nanoparticles Photocatalytically Decolorize Azo Dyes

Abstract

Bacterial polysaccharide is advantageous over plant, algal, and fungal polysaccharides in terms of stability, non-toxicity, and biodegradable nature. In addition, bacterial cell wall polysaccharide (CPs) is very little explored compared to exopolysaccharide. In this study, CPs have been isolated from thermotolerant Chryseobacterium geocarposphaerae DD3 (CPs3) from textile industry dye effluent. Structural characterization of the CPs was done by different techniques, viz., scanning electron microscopy-energy dispersive X-ray spectrometry (SEM–EDX), atomic force microscopy (AFM), Fourier transform infrared spectroscopy (FTIR), nuclear magnetic resonance (NMR) spectroscopy, and thermogravimetric analysis (TGA). CPs3 demonstrated compact non-porous amorphous surface composed of evenly distributed macromolecular lumps. TGA revealed a high thermostability (~ 350 °C) of the polysaccharide. FTIR and NMR confirm the polysaccharidic nature of the polymer, consisting of glucose units linked by both β-(1 → 3) and β-(1 → 4) glycosidic bonds. The functional properties of CPs3 were evaluated for industrial use as additive, especially antibacterial, emulsification, and flocculation capacities. A single-step green synthesis of silver nanoparticle (AgNP) was performed using CPs3. AgNP was characterized using ultraviolet–visible (UV–Vis) spectroscopy, transmission electron microscopy (TEM), AFM, and particle size analyses. The CPs3-stabilized AgNP exhibited potential photocatalytic activity against a broad range of azo dyes, congo red (88.33 ± 0.48%), methyl red (76.81 ± 1.03%), and malachite green (47.34 ± 0.90%) after only 3 h of reaction. According to our knowledge, this is the first report on CPs from C. geocarposphaerae. The results demonstrated multifunctionality of CPs3 in both prospective, CPs3 as additive in biotechnology industry as well as Cps3-stabilized AgNP for bioremediation of azo dye. © The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2023.

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Index Keywords

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Azo dyes

Chemicals/CAS

chloramphenicol, 134-90-7, 2787-09-9, 56-75-7; congo red, 573-58-0, 80701-77-5; glucose, 50-99-7, 84778-64-3, 8027-56-3; malachite green, 569-64-2; methyl red, 493-52-7; penicillin G, 1406-05-9, 61-33-6; polysorbate 80, 8050-83-7, 9005-65-6; tetracycline, 23843-90-5, 60-54-8, 64-75-5, 8021-86-1; xanthan, 11138-66-2; silver, 7440-22-4; Azo Compounds, ; Coloring Agents, ; Polysaccharides, Bacterial, ; Silver,

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