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Characterisation of Extracellular Polymeric Substances from Bacteria Isolated from Acid Mine Decant in Gauteng, South Africa

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Abstract : The toxicological manifestation of heavy metals motivates interest towards the development of a reliable, eco-friendly biosorption process. With that being said, the aim of the current study was to characterise the EPS from heavy-metal resistant bacteria isolated from acid mine decant on the West Rand, Gauteng, South Africa. To achieve this, six exopolysaccharide (EPS) producing, metal resistant strains (Pb101, Pb102, Pb103, Pb204, Co101, and Ni101) were identified as Bacillus safensis strain NBRC 100820, Bacillus proteolyticus, Micrococcus luteus, Enterobacter sp. Pb204, Bacillus wiedmannii and Bacillus zhangzhouensis, respectively with 16S rRNA sequencing. Thereafter, EPS was extracted using chemical (formaldehyde/NaOH) and physical (ultrasonification) methods followed by physicochemical characterisation of carbohydrate, DNA, and protein contents using chemical assays and spectroscopy (FTIR- Fourier transformed infrared and 3DEEM- three-dimensional excitation-emission matrix fluorescence spectroscopy). EPS treated with formaldehyde/NaOH showed better recovery of macromolecules than ultrasonification. The results of the present study showed that carbohydrates were more abundant than proteins, with carbohydrate and protein concentrations of 8.00 mg/ml and 0.22 mg/ml using chemical method in contrast to 5.00 mg/ml and 0.77 mg/ml using physical method, respectively. The FTIR spectroscopy results revealed that the extracted EPS contained hydroxyl, amide, acyl, and carboxyl groups that corresponded to the aforementioned chemical analysis results, thus asserting the presence of carbohydrates, DNA, polysaccharides, and proteins in the EPS. These findings suggest that identified functional groups of EPS form surface charges, which serve as the binding sites for suspended particles, thus possibly mediating adsorption of divalent cations and heavy metals. Using the extracted EPS in the development of a cost-effective biosorption solution for industrial wastewater treatment is attainable.

Keywords : biosorbent, exopolysaccharides, heavy metals, wastewater treatment
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