

Exopolysaccharides of industrial interest from cyanobacteria

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Many cyanobacterial strains possess, outside their outer cell membrane, additional surface structures, mainly of polysaccharidic nature, that may be referred to three distinct types: sheaths, capsules and slimes. The first type of envelope is constituted by a well-defined, electron dense thin layer, named sheath which surrounds single cells, single filaments or cell groups, reflecting their shape. The second type of structure is a polysaccharidic gelatinous layer, named capsule, intimately associated with cell surface, characterized by sharp outlines and so structurally coherent to exclude particles. The third type is an amorphous, mucilaginous shroud, named slime, only loosely associated with the cell surface. The slime may enclose a certain number of cells or filaments which, on their side, may also be characterized by the presence of capsules. In addition, many polysaccharide-producing strains release, into the culture medium, aliquots of their capsule or slime as water-soluble polymeric material (released polysaccharides, RPS). Most of these polymers are characterized by an anionic nature, owing to the presence of uronic acids and/or of other charged.

EPS-producing cyanobacteria can be considered a promising resource of biopolymers of applied interest or can be utilized for useful industrial processes. In particular, the physico-chemical characteristics showed by some of the exopolysaccharides released by cyanobacteria suggest the possible exploitation of this microbial group for the production of polysaccharides for specific industrial applications. Presently, more than 160 strains, belonging to 25 different genera, have been investigated with regard to the RPS production and to the characteristics of the polymers released into the surrounding environment. Based on their chemical and physico-chemical properties, cyanobacterial RPSs showed promise as thickening or suspending agents, emulsifying or cation-chelating compounds.

Research recently carried out with EPS-producing cyanobacteria pointed out promising perspectives in the exploitation of some strains for the bioremoval of heavy metals from polluted waters. The use of microorganisms for the removal of toxic heavy metals from polluted waters has been intensively investigated in recent years as an alternative to the conventional physico-chemical methods that are considered as less effective or too expensive if heavy metals are dissolved in huge volumes of water at relatively low concentrations. The good efficiency in metal chelation showed by many of the microorganisms studied has been related to the presence of a high number of negatively charged groups on the cell envelope. In this respect, the utilization of exopolysaccharide (EPS)-producing cyanobacteria seems to be quite promising, owing to the anionic nature showed by most of the cyanobacterial RPSs. A large number of researches recently carried out by the Authors' research group demonstrated the very good efficiency of some of the EPS-producing cyanobacteria in the removal of positively charged metal ions. Some very promising results were also obtained with waste waters of a plating industry containing Cr (VI), pointing out the potential of EPS-producing cyanobacteria for being used as biosorbents.

Another very interesting application of EPS-producing cyanobacteria is their use as inoculants in desert soils in order to contrast desertification and to favor soil rehabilitation. Within this context, these inoculation-based techniques have proved to be a viable and sustainable pathway to increase soil biomass, soil stabilization and soil fertility. It was also shown the role of the extracellular polysaccharidic matrix synthesized by cyanobacteria in giving the structure to the induced Biological Soil Crusts produced by the inoculants and to enhance their water trapping and retaining capability. These results demonstrated the potential of using ESP-producing cyanobacteria for developing an eco-friendly biotechnology aimed at contrasting desertification.