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An evaluation of heavy metal removal from wastewater using algae nanocellulose as a sustainable approach

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Keywords: Algal nanocellulose; Heavy metals; Wastewater treatment; Biological mechanisms; Sustainability

Extended Abstract

Environmental and water pollution are the main causes of the release of organic and inorganic substances into the environment such as water streams and air. These substances are usually released due to economic development, rapid industrialization and excessive population growth. Heavy metals are special as they are mostly biologically needed by nature and the human body in trace concentrations. However, the high concentrations of heavy metals deposition could harm the human body and biological organisms. Hence, efficient wastewater treatment is essential for economic growth. Wastewater that is produced from industries consists of a complex mixture of toxic recalcitrant organic and inorganic chemicals and heavy metals that are mainly difficult to manage. Predominantly, industrial wastewaters contain a high concentration level of heavy metals, nitrogen and phosphorus which can cause eutrophication effects in freshwater and marine ecosystems. This posed a serious threat to the environment, particularly the soil and water bodies. As a result, continuous release of this wastewater will eventually cause the accumulation of organic pollutants, toxic chemicals, persistent organic pollutants (POPs) and other undesirable compounds to the environment. The biodiversity, water quality as well as aquatic life could be highly improved by using effective wastewater treatment. It may represent an interesting addition to existing biological wastewater treatment by using microalgae synthesized nanocellulose for the removal of excessive heavy metals. Biological purification processes are now popular because they provide low-cost, high-performance technologies for addressing a variety of pollution problems. It was proven that the microalgae cell wall consisted of mainly negatively charged functional groups such as carboxyl, hydroxyl, phosphate, and amino. These negatively charged functional groups played a very important role in the metal-cell binding interaction. While the cell wall of microalgae for example *Chlorella* sp. consists of up to 80% carbohydrates including cellulose, the production of nanocellulose by using microalgae turned out to be one of the interesting ways for the removal of heavy metal. Furthermore, microalgae cultivation in wastewater enables microalgae biofuel production system coupling with wastewater treatment. Microalgae could also provide an economical approach to remove unwanted substances from wastewater while producing useful compounds such as phospholipids and carotenoids. To conclude, microalgal wastewater treatment via biological and physicochemical mechanisms involving nanocellulose, could be an attractive addition to the existing biological wastewater treatment.

Keywords: Microalgal nanocellulose; Phyconanotechnology; Wastewater Treatment; Bioaccumulation; Biosorption

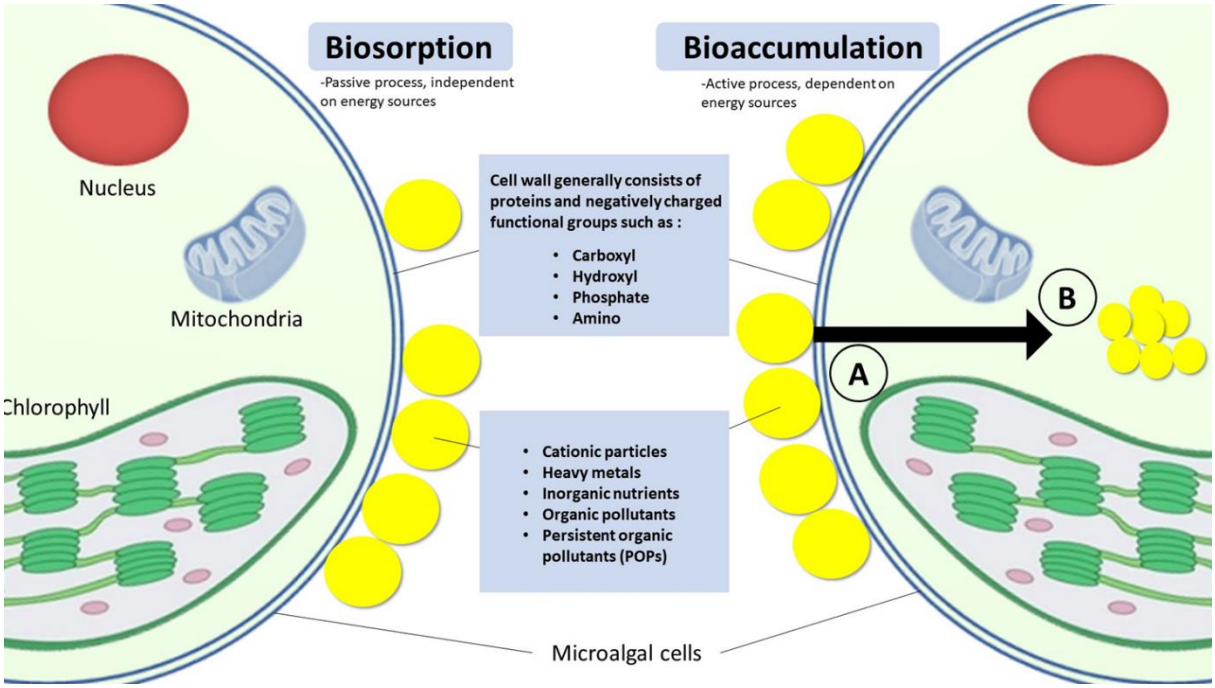

Figure 1: Image illustrating the mechanisms of biosorption and bioaccumulation of particles by using microalgal cells. A: In the process of bioaccumulation, particles will first adhere to the surface of the cells. B: Bioaccumulation occurs when the particles are taken into the cell bodies.

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