

DEVELOPMENT OF IRON-DOPED BACTERIAL CELLULOSE WITH *Ilex guayusa* FOR CADMIUM REMOVAL FROM AQUEOUS SOLUTIONS

Abstract

The presence of heavy metals in water bodies is a worldwide environmental and health problem, particularly affecting the vulnerable Amazon Region. In Ecuador, 35% of water resources contain dangerous levels of contaminants, posing an imminent threat to local communities. In this study, bacterial cellulose films were obtained using a substrate based on an ancestral plant called guayusa (*Ilex guayusa*) as an efficient and promising alternative for production in the region. Membranes with different percentages of iron (Fe) were developed for the removal of cadmium ions (Cd^{2+}) from aqueous solutions. Characterization results revealed that bacterial cellulose samples exhibited consistent FTIR spectra, with slight variations in the fingerprint region and in the $700\text{-}450\text{ cm}^{-1}$ region corresponding to the presence of Fe-O groups. In addition, SEM-EDS images confirmed the uniform presence of iron particles in the bacterial cellulose structure, with diameters ranging from $2\text{ }\mu\text{m}$ to $2.5\text{ }\mu\text{m}$ on the surface. Atomic absorption spectrometry results indicate that membranes with different percentages of iron (1%, 3%, and 5%) exhibit improved adsorption properties compared to the control. In particular, cellulose with 3% iron demonstrated the best performance across all evaluated Cd^{2+} doses (1 ppm, 1.5 ppm, 2.5 ppm, 3.5 ppm, 5 ppm, and 7.5 ppm), achieving removal percentages of up to 70% of the ions with an adsorption capacity of 2.6175 mg/g at higher concentrations. Consequently, bacterial cellulose membranes with 3% of iron particles constitute an alternative adsorption material for the efficient removal of cadmium ions in metal-contaminated aqueous media. This study offers an innovative, sustainable, and efficient alternative for the remediation of contaminated waters in a region where mining, extraction, and other human activities have had a significant environmental impact.

Key words:

Bacterial cellulose, *Ilex guayusa*, cadmium, adsorption, water remediation.