Wicherhamomyces anomalus biofilm supported on wood husk for chromium wastewater treatment

Toxic heavy metals are harmful pollutants increasingly discharged in the environment by natural and anthropogenic means. Due to its widespread use in industrial processes, chromium presents a significant impact on the surface waters and ecosystem services. Because of its non-degradability, it is transferred to the food chain occurring in different degrees of toxicity depending on its oxidation state. Hexavalent chromium Cr(VI) is a highly toxic water pollutant. It can originate from different anthropogenic activities such as leather tanning, pigment synthesis, electroplating and metal finishing.

The increasing awareness of chromium pollution has encouraged intensive efforts toward its removal. Hence, chromium removal is gaining importance in the environmental research community. Numerous studies have reported the application of several methods for this purpose.

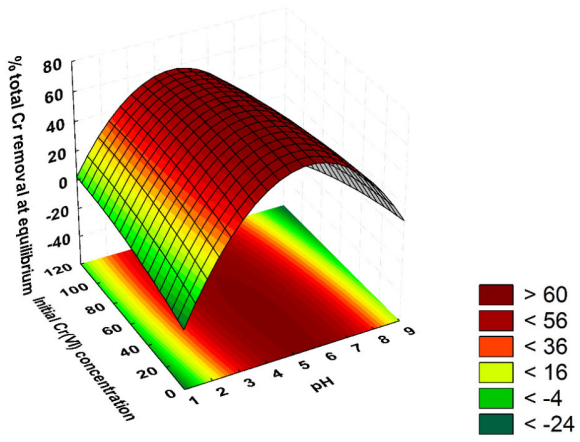

Fig 1. Second-order response surface plot in the chromium removal by *W. anomalus* biofilm on wood husk : dependence on initial chromium concentration and pH

In order to remediate to water stress, there is a need to develop efficient technological systems for metal recovery before the release of contaminated wastewater. Biosorption has aroused a significant interest as a cost-effective and efficient method for chromium removal from aqueous environment. It is defined as the ability of biomaterials to selectively bind ions or molecules from aqueous solutions. Biofilm-based biosorption is considered as an attractive process that has been used effectively for metals removal from industrial effluents. This technology involves different materials as a support for microbial cells attachment. Among these materials, we selected wood husk for a remediation application. This material is known to have a great ability to attach microbial

cells, providing also a source of cellulose for these ones. Microbial adhesion is a crucial step for biofilm formation. It is a key factor for its performance, since it assures the long-term stability of the system.

In this work, we investigated the use of microbial biofilm to remediate water bodies contaminated with chromium. A biofilm of yeast strain *Wickeramomyces anomalus* supported on wood husk was used to remediate chromium solutions, in batch and open systems. The adhesion ability of the chromium-resistant yeast strain on the wood husk was predicted by XDLVO theory and confirmed by environmental scanning electronic microscopy. A central composite design (CCD) was used for the optimization of the chromium decontamination in a batch mode.

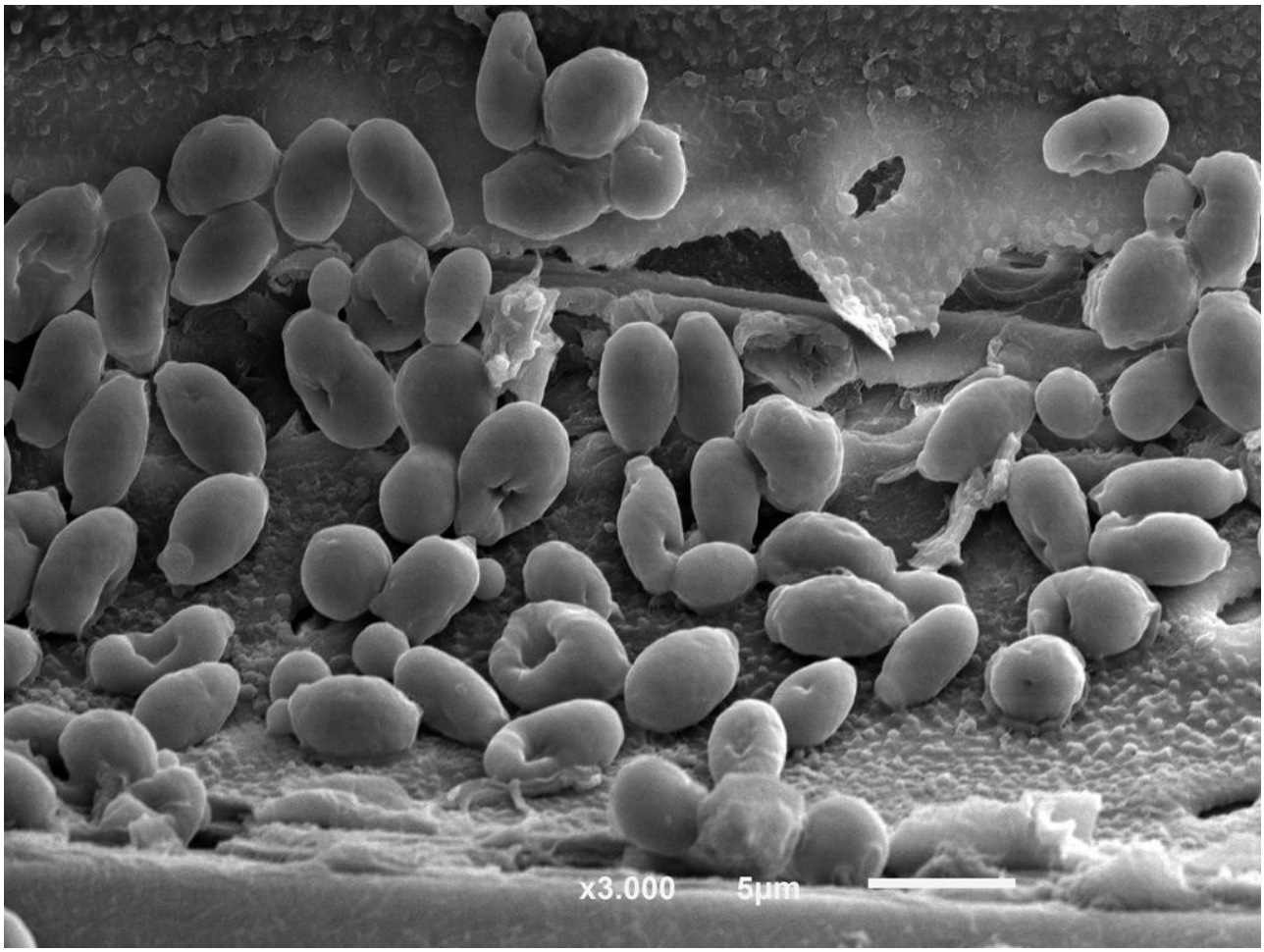

Fig. 2. SEM of *W. anomalus* attached to wood husk (3000×)

The study provided new information of great interest. Interestingly, the high coefficient of determination (R^2) value of 0.93 and 0.91 for Cr(VI) and total Cr removal, respectively, ensuring a

satisfactory fitting of the second-order regression model to the experimental data. In batch system, an acidic pH of 3.72 and 5.48, an initial chromium concentration of 10 and 16.91 mg/L and a support dose of 6.95 and 8.20 g/L were optimal for Cr(VI) and total Cr removal, respectively. In open system, we evaluated the retention capacity at different initial chromium concentrations. It was strongly related to metal concentration, a higher percentage of retained metal was observed with the highest chromium initial concentration (100 mg/L). This can be explained by the difference between the pollutant concentration in the solution and the pollutant concentration in the biosorbent, which is the main driving force conditioning the uptake process. The quantification of extracellular polymeric substances production related to the glucose concentration in the medium showed that a glucose exempt medium allowed the maximal extracellular polymeric substances production but led to the minimal chromium removal efficiency. While 20 g/L of glucose concentration presented the optimal condition for chromium removal. The obtained results make the yeast strain *W. anomalus* a suitable candidate for bioremediation.

Meryem Asri
Laboratoire de Biotechnologie Microbienne, Faculté des Sciences et Techniques, Université Sidi Mohamed Ben Abdellah, Fès, Morocco

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Meryem Asri, Naïma El Ghachtouli, Soumya Elabed, Saad Ibnsouda Koraichia, Alae Elabed, Bruna Silva, Teresa Tavares
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