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Efficient extraction of heavy metals from collagens by sulfonated polystyrene nanospheres

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Abstract

This work reports the feasibility of utilizing sulfonated polystyrene nanospheres (SPS NSs) to extract heavy metals from collagen solutions. We have endeavored to present a detailed study on the adsorption characteristics and mechanism of heavy metals including Pb²⁺, Mn²⁺, Cr³⁺ and Cd²⁺. The adsorption isotherms were fitted by the Langmuir and Freundlich models while the adsorption kinetics data were described by the pseudo-first-order, pseudo-second-order and intraparticle diffusion equations. The adsorption isotherms were better fitted by the Langmuir model, leading to theoretical maximum capacities of 50.7, 15.0, 8.7 and 39.0 mg g⁻¹ for the adsorption of Pb²⁺, Mn²⁺, Cr³⁺ and Cd²⁺, respectively. Isothermal titration calorimetry (ITC) measurements were conducted to detect the heat exchange of the adsorption processes. As a proof of concept, SPS NSs were practically applied in sequestering heavy metals from Talapia-fish-scale derived collagen. The effects of pH of the collagen solutions in the removal of metals were investigated. By a single treatment, the concentrations of the metal ions were decreased to the regulatory standards whilst the concentration of collagen proteins was well maintained.

Keywords: *Heavy metals; collagens; competitive adsorption; isothermal titration calorimetry; adsorption isotherms; protein purification*

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